Salmonid Enhancement Program

1981 Annual Report Summary

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Director's report

The Salmonid Enhancement Program (SEP) is five years old. As the Program matures, its highlights change. Last year was characterized by the construction of major facilities. This year, 1981, is one of record egg-takes and increasingly large returns of salmon.

Nitinat hatchery, in its first year of full operation, set a Canadian egg-take record. Expecting to take 10 million chum eggs, hatchery staff took advantage of the large number of adults returning to spawn and filled the hatchery to capacity with 28 million chum eggs and half a million chinook eggs.

Almost four times the expected number of eggs were taken for Pallant Creek hatchery, on the Queen Charlotte Islands. With 8.3 million chum eggs incubating as of December 31 this year, the hatchery is operating at full capacity for the first time. Chum and coho egg-take targets, of 4.2 million and 400,000 respectively, were met in Chilliwack hatchery's first year of operation.

Although SEP cannot take full credit for facilities constructed before 1977, these projects are good indicators of the potential production of SEP facilities. For example, the spawning channels at Fulton River and Pinkut Creek contributed 52.2 percent of the total sockeye harvest for the Skeena River. The total catch of 1.38 million sockeye was the largest on record.

Returns to the facility on the Big Qualicum River also serve as production indicators. Prior to any coho enhancement on the Big Qualicum River, the historical escapement averaged 3,500 spawners. In 1981, more than 65,000 fish returned, an all-time record for this river. It is estimated that "BQR" contributes another 100,000 coho to the sport and commercial fisheries.

Big production, however, is not the whole story of SEP. Throughout the province, dozens of small projects are operated by volunteers. Corporate support for these projects is also growing; B.C. Forest Products, Canadian Forest Products, Tahsis Mines, MacMillan Bloedel, and The Vancouver Sun, to name but a few, have supported enhancement projects this year.

The Vancouver Sun "project" is aimed at involving Lower Mainland schoolchildren in salmonid enhancement. It has been a tremendous success.

In addition to raising funds for SEP, the newspaper has done more than its share in informing the public about the importance of the salmonid resource and in encouraging public involvement.

SEP's community development program provides employment opportunities in underdeveloped areas of the province. SEP contracts community groups (many are Indian bands) to carry out a variety of projects, ranging from stream clearance and surveys to the construction and operation of hatcheries. In 1981, there were 14 such projects, employing 135 people on a full-time or part-time basis.

An evaluation of the community development program concluded that it is one of the best economic development programs for native people.

In an era when cost overruns and delays are commonplace, it is gratifying to note that the major projects under construction in 1981, including facilities at Kitimat, Chehalis, Tenderfoot and Inch, are on schedule and within budget.

Phase I of SEP will end in March, 1984. It is important to carry out some development work, such as reconnaissance and feasibility studies, prior to the end of Phase I, so that momentum is maintained into Phase II. The funds received in 1981 ($1.5 million) to carry out this work were less than hoped for; however, we are confident that much was accomplished with the funds provided. Table 1 shows SEP expenditures by program area from 1977 to 1982.

Late in the year, Phase II enhancement opportunities were identified. In 1982, this list will be further refined.

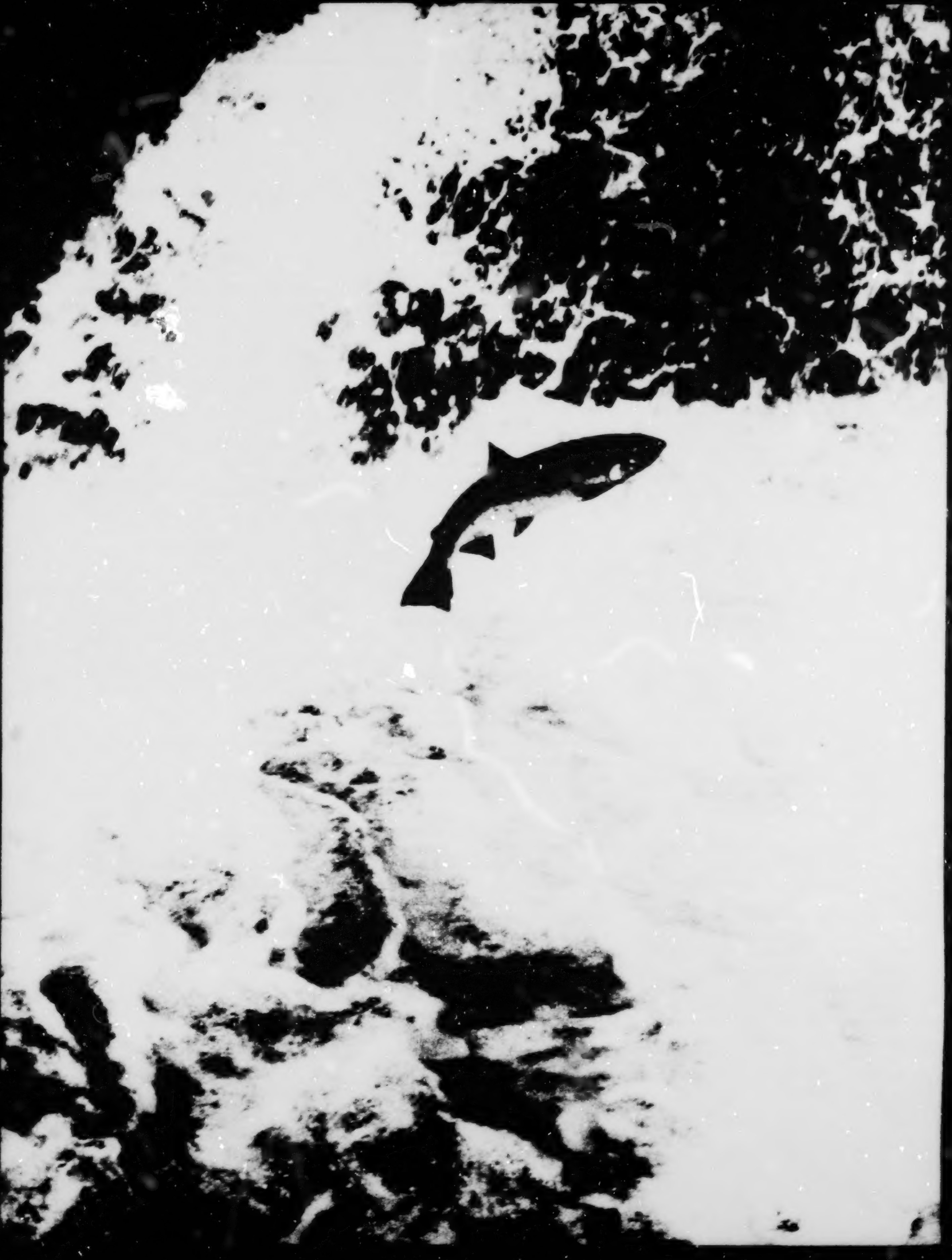
SEP is, of course, only one component of the Department's fisheries management picture. The Program is closely allied with Field Services Branch, which manages all fisheries on the Pacific Coast, and with the Fisheries Research Branch. We in SEP value their close cooperation and support.

The provincial government also plays a valued role in SEP, concentrating on the enhancement of sea-run trout, the steelhead and cutthroat. We welcome its continued support and participation.

SEP's two advisory groups, the Salmonid Enhancement Board and the Salmonid Enhancement Task Group, provided valuable input into program direction.

The Salmonid Enhancement Program is a government program that works.

N. W. Falkner, Ph.D.
Executive Director, SEP



What is SEP?

It depends on your perspective.

A commercial fisherman will tell you that SEP is supposed to mean more fish to catch, adding "the sooner, the better."

Processors will tell you that when the fish do start coming back, SEP will mean more jobs in the processing industry.

A schoolchild will tell you that SEP means caring for the fish in the stream near school — clearing out the shopping carts and rubber tires, and putting in good gravel so the fish can spawn naturally.

To a native Indian, SEP can mean a job working with a resource which has long been a part of his cultural heritage. It means on-the-job training and a chance to stay and work in his community. It also means that commercial fishing in these remote communities will have a better future.

An angler will tell you SEP means more fish, but she also might mention the small enhancement project she and her rod and gun club are working on.

To others, it means a construction job for a year or more, building a hatchery, a seasonal job, or carrying out field studies.

SEP staff have yet another point of view: a unique government program with well-defined objectives. They see the Program — and themselves — as being very accountable to the public for success or failure.

The Salmonid Enhancement Program has five objectives: to increase national income, to increase employment, to increase regional development, to improve native people's well-being, and to improve and preserve the salmonid resource and its environment.

- *Increased national income:* Basically, SEP is viewed as a program that will make more money than it costs to run. This is what a private company hopes for when it invests in a project, and what the government hopes for when it "invests" in SEP. The government tends to measure its investments against much broader standards than does a private company, because it must consider the interests of all people, rather than a limited number of shareholders. While a company can look at a program or project as a "bottom line" profit or loss, the government must also consider the social and economic costs of opportunities foregone. (For example, the benefits of enhancing a salmon stream are measured against costs, such as the cost of not logging the valley.)

Taking dozens of factors like these into account, SEP still comes out as a good investment.

- *Increased employment:* SEP creates meaningful employment both indirectly and directly, short-term and long-term. Indirect employment is sometimes difficult to measure, but it includes jobs created in fish processing and the tourism industries as a result of more fish being produced.

Jobs directly attributable to SEP are those such as building and operating salmon and trout hatcheries, clearing streams, conducting biological and engineering surveys.

- *Regional development:* One of the federal government's goals is to try to develop the less-developed regions (often also areas of high unemployment) of Canada. SEP fits in well here because many fishermen are located in small coastal communities, and most SEP projects are located away from large urban centers.

- *Improved opportunities for native people:* Several of the objectives of the Program are geared specifically to native Indians:
  - to increase employment of native Indians in the processing sector
  - to increase native food fishing catch
  - to increase the catch of the native commercial fleet
  - to provide employment opportunities in salmonid enhancement.

- *Preservation of the resource and its environment:* It's natural that a program such as SEP would consider this objective to be one of the most important. Every project is evaluated to ensure that it does not have adverse effects on other fish stocks or on the environment. Esthetic values, naturalness, and cultural and educational potential are also considered.

Fish production

The means by which SEP meets these objectives is, of course, through producing more fish. The Salmonid Enhancement Program began in 1977 with the stated aim of bringing back the population of salmon and sea-run trout (salmonids) to historic levels. In Phase I, this means the capacity to add 50 million pounds of fish per year to the existing catch.

In the five years since SEP began, several techniques have been used to increase the number of salmon and sea-run trout: hatcheries, spawning channels and platforms, lake and stream fertilization, fishways, stream clearance and fry colonization, to name but a few.

The provincial government is also involved in SEP, with particular responsibility for the enhancement of sea-run trout — steelhead and cutthroat.

In this time of restraint, government expects a very high rate of return on its investments, and SEP more than measures up.

Continuing the legacy of Pacific salmon: a coho begins its incredible journey back to its natal stream to spawn.

Photo by Terry VanderSar

How does SEP measure up?

SEP isn't a government program that, once started, never stops and is never questioned. SEP is under constant review, and its progress is measured against the targets established in 1977. Phase I of SEP ends in 1984, and unless it has been successful, that's the end of SEP. There is no Phase II unless Phase I measures up.

SEP has been badly affected by the impacts of inflation and extending the Program to seven years from five. These factors have "eaten into" SEP's allotment of $150 million over five years. However, an evaluation of SEP in 1980 showed that the Program is doing proportionally better than expected with fewer dollars. Inflation and "extension" have had major impacts on all five main objectives. However, SEP has done well, considering these major impacts.

SEP generates money

Originally, the benefit/cost ratio of SEP was targetted at 1.5:1. While individual projects may have higher or lower benefit/cost ratios, the average, up to 1981, now stands at 1.3:1. This means that for every dollar invested in SEP, the return on investment would be $1.30.

More jobs

At the outset of the Program, a target was set of 458 person-years[1] of new employment in the construction and operation of new facilities.

In 1981, SEP had exceeded, by 36 percent, this employment goal.

This excellent performance is due, in part, to the shifting of emphasis from large-scale projects to smaller-scale projects, which are more labor intensive. A second factor is the extension of the Program to seven years from five. This meant adding person-years to the original estimates for operating the facilities.

Regional developments

Many of SEP's major facilities and most of the community development projects are located in areas of high unemployment and where there is little or no economic development.

There are three other factors affecting performance in this account, in addition to the inflation and extension impacts already discussed. First, the shift in Program emphasis to chinook enhancement also affected performance in this account. Chinook are caught and processed mainly on Vancouver Island and the Lower Mainland, which are not considered undeveloped regions.

Second, most of the earlier projects were developed in the south coast of B.C., where more enhancement opportunities were ready to go. Also, there was a conscious decision to trade off some regional development objectives in order to improve the economic performance of SEP. (Projects in remote and northern areas of the province are more expensive to develop and operate.)

It was planned that, by the end of Phase I, about $200 million in benefits would accrue to the less developed regions, which are collectively defined as the area north of a line from Powell River to Bamfield. These benefits are found in the harvesting, processing and employment sectors. So far, about $88 million in benefits have been directed to this region.

Native people benefit, too

Since SEP's inception in 1977, some 266 person-years of employment for native people have been created, and about 32 of those are permanent jobs. Most of these were created in areas where unemployment ranges from 40-80 percent.

The number of permanent jobs created is less than originally targetted because the construction, and in some cases, the operation of SEP facilities, is contracted out to the private sector. SEP has no control over who the contractors hire.

The community development program, which generates many of the native Indian benefits, was evaluated in 1981. The report said "the [community development] program has been satisfying both to project employees and to the communities at large. The program's concentration on long-term job creation revolving around preservation of a highly-valued resource provides direct economic benefits, personal and community satisfaction, and a sense of working for the future."

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Anglers are some of the beneficiaries of SEP's steelhead enhancement programs. B.C.'s sport fishery, targetting on chinook, coho and steelhead, attracts anglers from across Canada, as well as American anglers from Washington to Florida — indicating the value of the sport fishery to tourism.

Photo by Valdemar Kamaldnieks

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[1] a person-year is defined as one year of work for one person.

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Saving fish and habitat

This is an admirable goal, but SEP has experienced difficulty in trying to pin it down. Basically, every proposed SEP project is evaluated according to its probable impact on the environment and the salmonid resource.

It has become evident that the manageability of enhanced stocks is one of the key criteria in enhancement. In 1981, SEP funded a number of studies to examine several aspects of this very important question.

Tallying the score

Of course, the means to achieve these social and economic goals is through fish production. How does SEP stand here?

By 1981, SEP had achieved a production capacity of 35.9 million pounds, or about 72 percent of the target of 50 million pounds by the end of Phase I. However, the mix of production for each species has been modified in response to changing needs and opportunities. (See Figure 1.)

Sockeye production is close to 70 percent greater than the original target, largely because of the success of the lake enrichment program.

In contrast, chum production is only about 45 percent of the initial target. Potential chum projects were dropped when funding for new projects was reduced and because market demand for chum had fallen severely. There are also problems regarding when and where to harvest chum salmon. Fisheries managers are reluctant to add an enhanced stock into complicated mixed stock fisheries, in which most chum are caught. One answer to this problem would be to harvest the chum closer to their home streams, when they aren't mixed with other stocks. However, the flesh quality of these fish deteriorates as they return to the stream to spawn.

Chinook salmon production is about 70 percent of target because enhancement opportunities in the Fraser River often are not economical, or the fish produced would not be manageable without some negative impacts on other stocks. Also, enhancement technology is relatively expensive and in its infancy for some chinook stocks, such as those in the upper Fraser, which may spend up to two years in fresh water.

Coho production is about 80 percent of target because the enhancement requirements and problems of this species are similar to that of chinook.

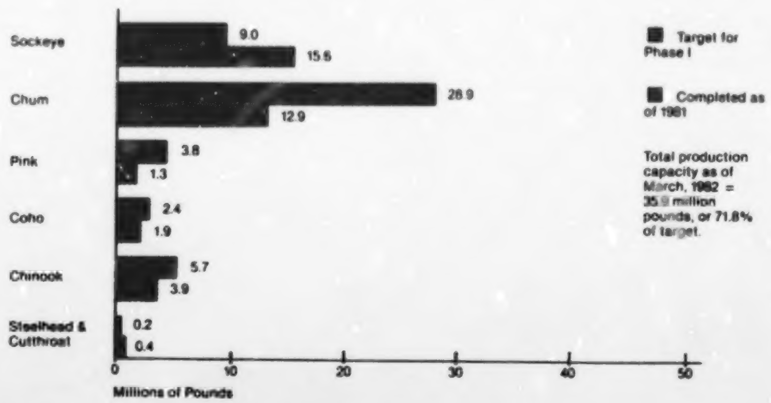
Pink salmon production is expected to be below the original target of 3.8 million pounds, mainly because there is no proven enhancement technique for this species.

By 1984, steelhead and sea-run cutthroat production is expected to be about twice that of the original target. The target of 200,000 pounds per year, set in 1977, was based on the current enhancement techniques known at the time. These included hatchery rearing, an expensive procedure for steelhead, because they may require two years in fresh water before migrating to sea. Now, however, the more recent technique of releasing unfed fry into barren streams or streams of low productivity seems to be reasonably effective and significantly less expensive than any other enhancement technique for steelhead.

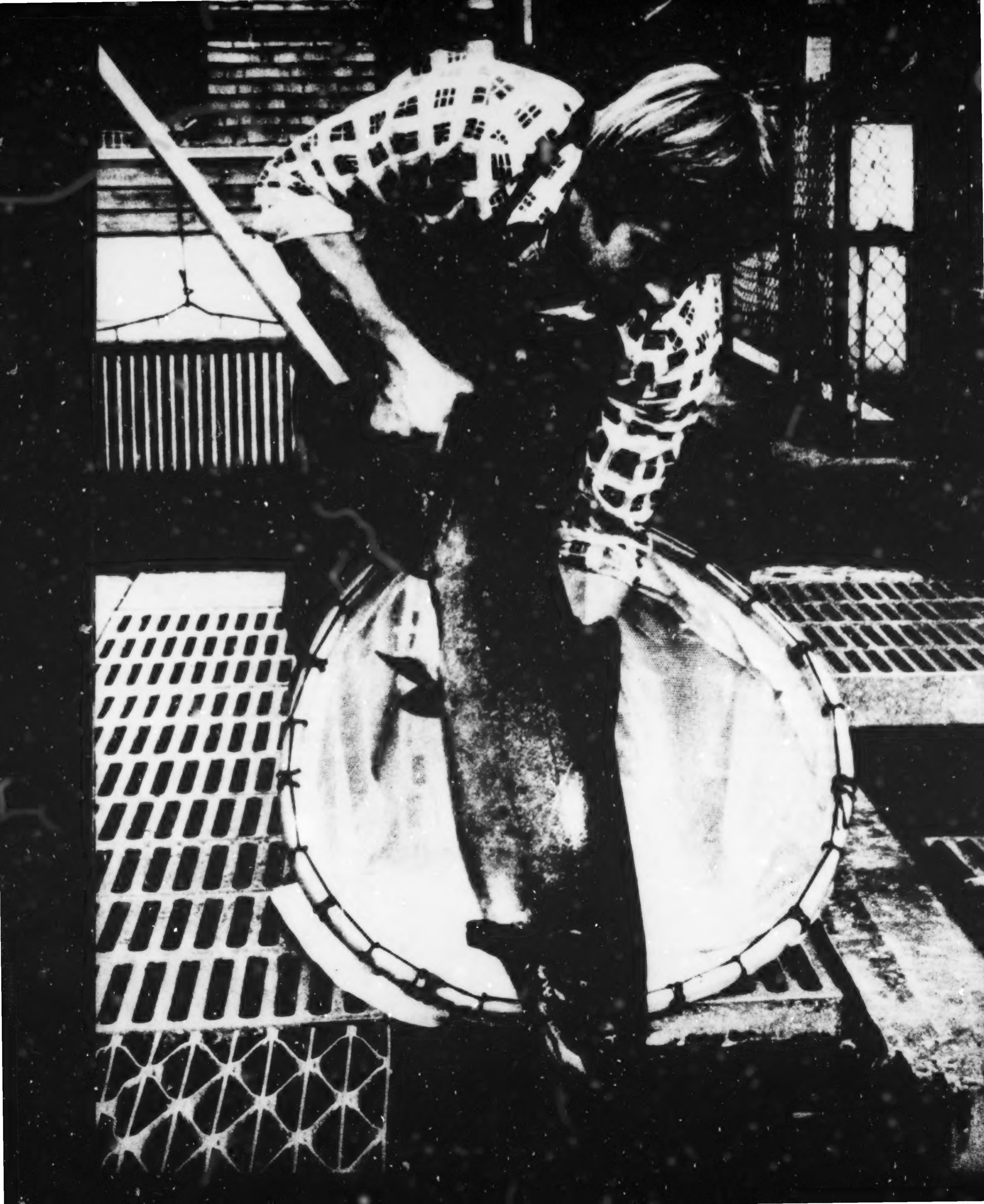
Radio contact aids commercial fishermen in keeping up-to-date on fishing opportunities and weather conditions. In 1981, the commercial fishing fleet caught an estimated 75,962 tonnes (landed catch) of salmon, at a total value of approximately $158 million, compared to 51,628 tonnes, at $117 million, in 1980.

Photo by Terry VanderSar

Figure 1: SEP Production Capacity by Species: Phase I Targets and Performance to Date*



* Production capacity measures the capacity of facilities which have been constructed since 1977 (SEP facilities only) and are now operational. The capacity is stated in terms of expected future adult catches, using current facility capacities, current expected egg to adult survival rates of enhancement techniques, and projected future Canadian catch rates.



A look at SEP facilities

Let's put it simply: it's a numbers game.

In 1981, SEP major and minor facilities produced some impressive numbers:

- more than one billion salmonid eggs were incubated at 22 facilities, spawning channels and controlled-flow streams
- Nitinat hatchery collected approximately 28 million eggs from 11,000 chum salmon, the largest single egg-take in Canada's history
- more than 267 million juvenile salmon and steelhead trout were released from hatcheries and spawning channels
- approximately four million salmonids are expected to return as adults over the next four years (Table 2 and 3), an increase of 17 percent over expectations for the 1980 releases.

Eighteen hatcheries were operational in 1981. This includes the Nitinat and Chilliwack facilities, which were fully operational for the first time in 1981 and operating at, or near, full capacity for each of the species being enhanced (Table 4).

All pre-SEP facilities — Capilano and Quinsam hatcheries and the original Big Qualicum, Puntledge and Robertson Creek hatcheries, plus the Fulton, Pinkut, Jones and Big Qualicum spawning channels — are operating at full capacity and continue to make major contributions to B.C. fisheries.

A fish culturist determines the sex of chinook brood stock returning to the Big Qualicum facility. The fish are held until ripe and then they are stripped of their eggs, or milt, for hatchery operations.

Photo by Terry VanderSar

Most egg-takes met expectations, although low chinook salmon escapements limited production at the Capilano, Birkenhead, Puntledge and Chemainus projects. Some chum salmon facilities relying on unenhanced stocks — Bella Coola, Puntledge, and Little Qualicum — did not reach egg targets; significant returns are expected in 1983 or 1984, and these facilities should then be operating at capacity.

After several less productive seasons, Pallant Creek hatchery operated at near-capacity levels in 1981, due to an unexpectedly good return of chum salmon.

The new $2.5-million Quesnel hatchery operated for the first time, at a pilot level, in 1981. Approximately 100,000 Quesnel River chinook eggs were incubated. The facility is expected to be fully complete in time to accommodate eggs collected from 1982 brood stock.

One SEP project that was rejuvenated in 1980 — a hatchery at Bear River — is working toward production goals. From the original 2.2 million pink salmon eggs collected in 1980 for the Bear River facility, 1.5 million of the resulting fry were released directly into Bear River in the spring of 1981. The remaining fry were released from sea pens into the Bear River estuary.

Five streams located in the Tlupana Inlet contribute chum brood stock for operations at the Conuma hatchery. In 1981, approximately 8.5 million resultant chum fry, plus 194,000 chinook fry, were produced at this facility and released in their native streams. In the fall, 15 million eggs were collected from chum brood stock.

Steelhead runs to Robertson Creek hatchery were the highest on record — more than 1,800 — even with the interception by the commercial fishery. Due to the 1980 expansion of the hatchery, which included plans to double steelhead production, this system may provide for a major steelhead fishery over the next few years.

Approximately 480,000 steelhead smolts are expected to be released from federal hatcheries in April and May, 1982. The new facility at Chilliwack and the expansion at Robertson Creek accounted for a total of 60 percent of the production. Smolts at the Chilliwack hatchery were initially reared at the Fraser Valley trout hatchery in Abbotsford, and they are the best smolts produced, in terms of quality and size.

The provincially-operated trout hatchery in Abbotsford continued with its steelhead and cutthroat enhancement programs. In 1981, more than 90,000 steelhead fry, originating from 1980 brood stock from the Coquihalla, Alouette and Little Campbell Rivers, were released into their native streams.

Various existing facilities, including those operating on a pilot scale, were upgraded in 1981 — Kitsumkalum pilot hatchery, Pallant Creek, Robertson Creek, Quinsam and Big Qualicum hatcheries and Little Qualicum spawning channel. All of these facilities are expected to reach full production within the next few years, when the juveniles released from SEP facilities return as adults.

Fishing for answers

The day-to-day workings at a hatchery sometimes include research projects or studies. These projects, ranging from juvenile production strategies to fish nutrition, are often cooperative efforts between hatchery staff and research scientists.

Studies on controlled reproduction of salmonids continued through 1981 at Capilano hatchery. The purpose of controlling reproduction is twofold: to increase the proportion of female salmon in hatchery stocks, thus increasing the number of eggs; and to reduce the number of jacks (younger and smaller but sexually mature male salmon) returning.

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Sterile and all-female groups of coho released from Capilano hatchery in 1980 contributed to both commercial and sport fisheries during 1981. As hoped, the all-female group returned to the hatchery in large numbers, while no completely sterilized fish returned. The sterilized fish are expected to stay in the fishery longer and grow to a larger size; ultimately, this leads to an increase in the landed catch value.

Over the past few years, scientists at the West Vancouver lab have been developing diets for each of the five species of Pacific salmon. In 1981, growth rates of chinook that were fed experimental diets were much better than those reared on the imported diet currently being used. Also encouraging was the fact that the West Van diet produced more adult salmon.

Since scientists learned that releasing smolts at different sizes or at different times of the year affect the rates of return, they have been working to determine the optimum size and time of release. Experiments with juvenile coho in 1981 at Robertson Creek and Quinsam hatcheries pinpointed optimum sizes and release times for maximum adult returns to those facilities.

Managing the mix

One of the primary concerns in the development of an enhancement facility lies in the problem of managing the returning enhanced stocks. Manageability problems arise when a number of stocks and/or species mix in a common fishing area. Because the various species and even different stocks of the same species reproduce at different rates, they should be managed and fished separately, each according to its own rate of production. The problem is compounded when stocks of different productivities mix, because more productive stocks can withstand a much higher rate of exploitation.

Management of overlapping fish populations has always been a difficult task, due, in part, to a general lack of data (such as migration routes, timing, and strength of the stocks), along with biological uncertainty. In 1981, nineteen SEP-funded manageability studies were undertaken by the Field Services Branch in an attempt to collect these data. The studies were conducted in areas which have already been affected by SEP enhancement production or in areas where enhancement has been proposed. A variety of methods, including test fishing, creel surveys, sampling, tag and recovery, enumeration, or reconnaissance, were used.

New developments

The rapidly-changing economic condition in B.C. had everyone — including engineers and construction companies — shifting gears in 1981, and it complicated the task of constructing major SEP facilities.

Early in the year, competition amongst contractors was poor and the prices were high. However, as the year progressed and the economy deteriorated, competition intensified and prices dropped.

The Kitimat and Chehalis projects were the most affected by economic conditions. Tenders called in July for the Kitimat facility, for example, were much higher than anticipated. The work was divided into a series of smaller contracts, in an attempt to keep the cost down; this policy resulted in a saving of $2 million.

By the end of the year, approximately 20 percent of the $9.6-million Kitimat hatchery was completed. The facility is designed to enhance 17 stocks from four river systems.

To take advantage of the low construction prices later in the year, contracting for the Chehalis facility was accelerated to late 1981 from early 1982. Consequently, this project was ahead of schedule by the end of 1981. The $6.8-million hatchery (about $700,000 less than originally estimated) will enhance stocks of chinook, chum and coho salmon and cutthroat and steelhead trout from seven rivers in the Harrison-Chehalis area.

Because unacceptable bids were also received for the Tenderfoot Creek hatchery, the work was divided into several small contracts — resulting in a 33-percent saving. By year-end, construction was almost complete. However, construction delays, coupled with staffing restraints, restricted operations at this coho, steelhead and chinook facility in 1981.

Construction of the new $6.1-million Nitinat hatchery was completed in time for the record egg-take of 28 million eggs.

The first stage of the Inch Creek facility, costing $1.1 million, was completed by the end of the year. This new facility replaces a temporary pilot incubation box, located nearby.

Design is well underway for a pilot facility for chinook and coho on the Eagle River, west of Revelstoke. This facility has been planned so that it can be easily expanded to deal with all South Thompson stocks, or modified to shift its emphasis to other species or stock mixes.

In addition, crews conducted reconnaissance and feasibility studies in the Fraser River and in the Johnstone Strait-Central Coast area; many promising sites for future enhancement facilities are currently being investigated.

Approximately $12.9 million were spent on new facilities.

SEP engineers design the enhancement facility and develop the detailed specifications for it, then they contract various companies to carry out the construction. In 1981, six enhancement facilities were under construction and several other existing facilities were renovated.

Photo by Koos Dykstra/Image Finders

SEP in the community

SEP's community development projects involve the old-fashioned concept of give and take. The projects provide Indian bands and community groups with on-the-job training and employment. For SEP, it's another way to get the work done.

It's an arrangement that works. The continuation of the projects from year to year and the number of people involved reflect the public's support of the program.

In 1981, community groups and bands operated 14 projects throughout B.C. The community development program cost a total of $2.9 million. During the busiest months of the year, up to 135 people were employed on community development projects.

The scope of the projects runs the gamut in enhancement technology: operation or construction of incubation boxes or small hatcheries, stream clearance, fry salvage and colonization, or net-pen rearing.

Initially, the projects are operated under close supervision by SEP's project coordinators. However, as the expertise of the contracted employees increases, SEP involvement is reduced to providing advice. Ideally, the groups will eventually run the projects independently, under the direction of the Program.

Additional human resources include the Small Projects Unit staff, who are "on call" for technical support for both the public involvement and community development programs. They also develop and test innovations in enhancement techniques.

In 1981, the Unit served in a consultative role to 37 projects, ranging from reconnaissance and feasibility of potential sites for enhancement to operation of a small hatchery.

Who did what where

In 1981, community groups worked on salmonid enhancement projects throughout the province, from Masset to San Juan, Vancouver to Smokehouse Slough (Table 4):

- the Kispiox band developed a pilot groundwater incubation and rearing facility for chinook and coho
- the Cowichan band continued its operation of a chum, chinook and coho hatchery
- B.C. Institute of Technology students reared chinook to pan size in sea pens in Vancouver's False Creek, and then helped to coordinate the second annual children's fishery for these salmon. BCIT students also operated a mini-hatchery for steelhead, chinook, coho and cutthroat trout on the Seymour River; this facility serves as a training center as well as a small production facility
- the Chehalis band operated a pilot facility on the Chehalis River, developed and operated another pilot incubation facility on Smokehouse Slough, and worked on various aspects of salmonid enhancement
- the San Juan Enhancement Society continued operating its incubation and rearing facility, located near Port Renfrew, for coho and chinook salmon
- inmates and supervisory staff of the Alouette River Correctional Center continued their enhancement work with coho and steelhead stocks
- the Bella Bella band continued to operate a chum hatchery
- the Sechelt band reared chinook and coho in sea pens; the project's objective is to enhance the local chinook and coho sport fishery. The band also incubated coho eggs at two pilot hatchery sites at Gray Creek and Walters Brook. The eggs were taken from marked adults that had returned to the net-pen site
- the Sliammon band operated a chum and coho facility near Powell River and carried out stream clearance
- the Nanaimo Community Employment Advisory Society operated a hatchery for chinook, coho, steelhead and chum, as well as carrying out fry salvage and colonization
- the Masset band operated a small hatchery for chinook and coho stocks of the Yakoun River on the Queen Charlotte Islands
- the Kincolith band continued its project for enhancing chinook and coho on the Kincolith River, a tributary of the Nass; the band also is developing a permanent hatchery facility for chinook and coho (to be completed in 1982)
- the Nimpkish band operated its chum and sockeye hatchery at Willow Creek
- the Thornton Creek Enhancement Society took over operation of the Thornton Creek hatchery in September, 1981. Approximately 1.4 million chum eggs from Thornton and Salmon Creek stocks are incubating at the hatchery; chum fry will be released in April, 1982.

In 1981, more than a dozen projects throughout B.C. were operated by Indian bands and community groups under contract to SEP. Under SEP's supervision, the groups carry out various salmonid enhancement activities — collect brood stock, operate incubation boxes or hatcheries, rear fish before release, salvage fry or carry out fry stocking programs. Stream enhancement work is also undertaken.

Photo by Linda Thorson

The volunteers' role

Come and get your feet wet. Public participation is one aspect of SEP that makes it special to us and special to you.

SEP now relies on a volunteer work force of 7,000 individuals in B.C., ranging from elementary schoolchildren to loggers, commercial fishermen to urban planners. Municipal representatives, seeing the value of preserving the streams and fish for the community, are calling SEP and asking how they can incorporate fish values into community planning processes. Individuals want to produce fish in their backyards. Schoolchildren are able to encourage land developers to work more carefully so that their fish can live. Rod and gun clubs and commercial trollers alike, as users of the resource, are now "putting something back." Forest and mining companies, pressured by their workers or by company policy, are putting in time and effort to save the salmon or to reduce the negative impacts of their work on fish and fish habitat. These examples show the public's increasing awareness of the importance of fish.

With help from SEP's six fisheries-trained community advisors, volunteers initiated more than 150 projects in 1981. Many volunteers were involved with incubation box projects. In 1981, approximately 837,000 juvenile salmon and trout, produced under the "public participation" banner, were released into various B.C. creeks, streams and rivers (Table 4). Expected adult production is 15,000.

Volunteers also involved themselves with other projects in 1981, such as clearing streams or improving habitat, capturing salmon and trout brood stock, feeding or salvaging fry, and counting salmonid stocks.

Although the community advisors are available for technical expertise and guidance, many of the volunteers approach their projects with innovative ideas of their own and prove, time and again, that there are always new ways to do old jobs.

Many public participation projects include incubation boxes and the subsequent release of resulting fry into their stream of origin. The scale of the projects ranges from in-class incubators in schools to small hatchery operations.

Photo by Joe Kambeitz

Schools of fish

In 1981, the Educator's Package, called *Salmonids in the Classroom,* was used in 53 school districts throughout B.C. to teach elementary and high school students about the resource. As a result, many schools also initiated volunteer enhancement projects, which gave students the opportunity to put theory into practice.

In an attempt to attract youngsters into the swim of things, SEP produced a draft of an Educator's Package aimed at children in kindergarten to grade three. The material should be available to schools in the fall of 1983.

SEP is hoping that the youngsters' exposure to salmonids may foster in them a lifelong interest in the resource.

Shaping SEP

The 12-member Salmonid Enhancement Board – consisting of private sector appointees and federal and provincial government members – provides input concerning the management and direction of the Program directly to the Minister of Fisheries and Oceans. In 1981, the Board was occupied with planning and preparations for Phase II.

The 25-member Salmonid Enhancement Task Group is a public advisory group reporting to the Board. It consists of representatives from the commercial and sport fisheries, native people, consumers, forestry, hydro, fish processing, mining, tourism and media.

The Task Group met four times in 1981. One of the year's highlights was the preparation and submission of a report to the Salmonid Enhancement Board on Phase II.

Gone fishin'

The 1981 "children's fishery" at Vancouver's False Creek hooked 4,000 people, half of them nine- and 10-year-olds dropping a line for the first time.

This popular event is sponsored jointly by SEP and the B.C. Institute of Technology. As part of the fish culture course, BCIT students rear chinook, originally from Capilano hatchery, in the False Creek sea pens. The chinook are released in late spring, giving Vancouver-area children an opportunity to catch some pan-sized salmon.

Approximately 12,200 chinook yearlings were released in False Creek for the 1981 event, held over two weekends in May and June. Organizers estimated that 7,200 chinook were caught. Of the 5,000 eluding capture, approximately 1,500 are expected to return as adults to Capilano hatchery or be caught in other fisheries.

This was the second year of the fishery.

Save the Salmon

A major daily newspaper, a few sportfishing enthusiasts, SEP, and thousands of Lower Mainland students have proved to be a winning combination.

In May, 1981, The Vancouver Sun announced its *Save the Salmon* campaign – a commitment to raise funds to help SEP increase west coast salmonid stocks. By the end of the year, The Sun had funded some enhancement work, done by elementary and high school students, on creeks and streams in North and West Vancouver. The remainder of the funds was held as seed money for other projects, planned for 1982.

Research: Investing in the future

The bottom line is efficiency. That's what research scientists are striving for when they investigate better ways to produce salmon and trout in enhancement facilities. Success is measured by the survival rates of juvenile salmonids and their subsequent return as adults.

Cut and dried?

Maybe not, when you consider all the things that can happen to a fish in a lifetime. In an incubation facility, some eggs may fail to fertilize. If the eggs do fertilize, other problems may crop up: the water may be too warm, too cold, or there may not be enough of it. There may be too many fry in the rearing trough at the same time. There may be outbreaks of disease. The diets may be poor. The fish may be released at a time or at a size that is less than optimum for adult returns. Or the fish may not adapt as well as expected to salt water.

In 1981, SEP funded 13 federal research projects. Many projects are undertaken jointly by Fisheries Research Branch staff (based at the West Vancouver Laboratory, the Pacific Biological Station in Nanaimo, and the Rosewall experimental hatchery north of Qualicum Beach) and SEP hatchery staff. All the projects are aimed at increasing our knowledge about Pacific salmonids. By doing that, the research team will be able to determine the most effective and efficient enhancement techniques for optimizing adult returns.

Salmonid diets, disease control, controlled reproduction and lake enrichment were just a few research projects funded by SEP in 1981. While some studies are conducted in DFO research facilities — the Pacific Biological Station, the Rosewall experimental hatchery, and the West Vancouver Laboratory — other research projects are carried out in hatcheries.

Photo by Marj Trim

Lake enrichment a hit

A funny thing happened when SEP poured tonnes of commercial grade fertilizer over several B.C. lakes.

The fish grew fat.

The results help tell the story of the lake enrichment program: approximately 1.3 million adult sockeye returned in 1981, from the 19.7 million smolts that migrated from four treated lakes in 1979. This was 400,000 more fish than SEP had bargained for.

Crews in aerial tankers spray liquid fertilizer over selected lakes frequented by sockeye salmon. The addition of fertilizer to the lakes results in a three- to five-fold increase in plankton, on which salmon feed.

The sockeye make the most of the extra food — smolts migrating from the enriched, or fertilized lakes generally weigh twice as much (four grams) as smolts originating from untreated lakes. Research scientists believe that the size of the smolts is directly related to their subsequent marine survival; in other words, the heavyweights may have the best chances of surviving the ocean migration, and ultimately, of returning to the rivers to spawn.

In 1981, Great Central, Henderson, Hobiton, Kennedy-Clayoquot, Bonilla, Curtis, Lowe, Kitlope, Ian, Awun and Eden Lakes were treated with a total of 281 tonnes of fertilizer. Results of the 1981 work will be available in 1983, when the adults are expected to return.

Under the looking glass

Other major federal research projects in 1981 included controlled reproduction, nutrition and diet, and smolt size and time of release; these studies were conducted at various SEP facilities.

Disease control and disease diagnostics are other important facets of SEP research. Scientists are investigating the feasibility of a vaccine to combat bacterial kidney disease (BKD) in salmonids. BKD is a widespread, chronic disease that takes its toll on salmonids out at sea, rather than in hatcheries. Fortunately, careful fish culture practices have proven to be good preventive medicine against BKD in hatcheries.

Water quality and incubation requirements were also examined in 1981 in an effort to develop and standardize techniques used in hatcheries. Factors such as oxygen levels, water hardness, water temperature and the eggs' sensitivity to mechanical shock all influence the survival rate of the eggs.

Under provincial jurisdiction, research and development projects continued in 1981 for the enhancement of steelhead stocks on the Keogh River. To determine the feasibility of net-pen culture of salmonids in lakes, crews released 18,000 large smolts (63-105 grams each) into a neighboring stream, Mills Creek, at Port McNeill. Results of this experiment will be available when these fish return as adults.

Fish habitat monitored

In 1981, SEP planning biologists and habitat management representatives set out to identify current habitat problems affecting overall fish production and future trends which could have an impact on SEP.

Three basic recommendations emerged from this exercise: more participation in SEP by industry, in the form of compensatory enhancement; greater use of habitat restoration opportunities; and resolution of habitat protection issues.

SEP in the future

For many people, SEP has been an article of faith. In the beginning, there was little more to go on than a vision of what SEP could be. Many people were involved in the planning and preparation for Phase I. Those working in SEP have labored diligently for five years, knowing that they could not expect to see real returns from their efforts for perhaps eight or ten years.

Commercial fishermen, anglers and those in the tourism and processing industries have supported SEP, but many have yet to see a single fish produced by the Program.

The SEP volunteers have given their financial and moral support, as well as given their time. For them, the benefit is even less tangible. The benefit will lie in knowing that they had a part in helping the salmon and trout return to their natal streams in greater numbers.

Faith helps build legacy

For five years, people have had faith in SEP. Now, there are the first signs that the faith was well founded. By 1981, salmon and trout were returning in increasing numbers. Fish were coming back to the newer facilities for the first time.

From 1982 onward, the returns should be even higher. Enhanced fish will appear in the commercial, sport and native food fisheries in even greater numbers. The life cycles will repeat, and the legacy of SEP will continue into the next century.

Phase II: A new start

Phase II of SEP would be designed to build on the results of Phase I. What happens to SEP when Phase I ends in March, 1984 depends largely on two things: the success of Phase I (whether SEP was a good investment), and the planning for the continuation of the Program.

The shape of SEP in Phase II is being determined now. In 1981, in a major effort toward planning Phase II, all possible enhancement opportunities were identified. Most of the list of projects came from extensive surveys undertaken by SEP in Phase I. Fishery officers and Fish and Wildlife Branch staff, because of their familiarity with local conditions, provided valuable suggestions. The public, including sport and commercial fishermen, also contributed suggestions, and these have been included in the initial list of 510 opportunities.

Over the next eighteen months, this list will be constantly refined as new information comes to light. It will form the backbone of the Salmonid Enhancement Program in the next phase. The features of the Program will be determined by the mixture of the types of projects and their locations. The character of SEP will be formed, in part, by what the public wants the next phase to be. It may look a little different from SEP's Phase I, but you will see a family resemblance!

In years to come, the results of SEP's efforts will become increasingly apparent; more fish will appear in the commercial, sport and native food fisheries, and the careful management of these fisheries will ensure the continuation of Pacific salmon.

Photo by Terry VanderSar

Table 1: SEP Expenditures by Program Area (in Thousands of Dollars)

	1977/78	1978/79	1979/80	1980/81	1981/82
Program Area					
Major Production Projects	$ 1,621	$ 6,754	$11,974	$12,847	$12,897
Minor Production Projects	252	726	1,098	1,461	1,212
Pilot Production Projects	283	284	135	244	181
Facility Operations and Maintenance	1,344	2,803	3,820	5,777	8,150
Community Development Projects	453	1,929	2,813	3,168	2,959
Lake Enrichment	307	676	1,095	1,345	1,454
Public Involvement	505	829	830	874	1,051
Reconnaissance/Feasibility Studies	1,581	754	1,508	1,588	990
Manageability and Environmental Studies	764	1,725	1,267	1,488	730
Evaluation/Assessment Studies	354	608	157	402	332
Research Studies	459	461	644	691	396
Program Planning and Direction	791	1,032	1,196	1,633	775
Provincial Program (Federal Share)	364	865	688	744	376
Provincial Program (Provincial Share)	264	289	1,243	1,250	1,250
TOTAL	$ 9,342	$19,735	$28,468	$33,512	$32,753
Source of Funds					
SEP Phase I	$ 7,878	$17,146	$24,725	$28,462	$26,911
DFO* Contribution	1,200	2,300	2,500	3,800	4,592
Provincial Share	264	289	1,243	1,250	1,250
TOTAL	$ 9,342	$19,735	$28,468	$33,512	$32,753
Phase II Program Development	–	–	–	–	$ 2,466

* Department of Fisheries and Oceans.

Table 2: Summary of 1981 SEP Fish Production*

Species	Juveniles Released	Expected Adult Production
Sockeye	203,797,200	2,747,209
Chum	98,263,254	985,771
Pink	8,634,380	259,971
Coho	5,875,989	766,610
Chinook	19,888,149	396,013
Steelhead	723,125	16,554
Cutthroat	84,860	5,560
TOTAL	337,266,957	5,177,688

* Includes production from all SEP facilities and projects, and lake enrichment.

Table 3: Forecast Catch from Existing SEP Projects* at Full Capacity**

	Canadian Catch	
Species	Thousand of Pieces	Millions of Pounds
Sockeye	3,868,627	19,916,425
Chum	1,261,678	14,649,321
Pink	348,668	1,513,322
Coho	661,305	3,654,380
Chinook	592,499	5,522,064
Steelhead	31,751	327,033
Cutthroat	6,280	64,684

* Facilities constructed before SEP as well as SEP projects.

** Projected Canadian commercial, sport and native food fish catches, each year.

Table 4: Juvenile Fish Production from SEP Facilities in 1981 and Adult Production at Design Capacity*

					AT DESIGN CAPACITY		
Project	**Type**	**Species**	**Juveniles Released**	**Expected Adult Production**	**Adult Production (Pieces)**	**Catch[1] (Pieces)**	**Catch (Pounds)**
Facilities							
Pallant Cr.	Japanese hatchery	coho	72,000	1,440	12,150	5,443	35,993
		chum	2,747,000	54,940	145,800	63,510	717,668
		pink	1,036,000	51,800	—[2]	—	—
Mathers Cr.	pilot hatchery	pink	50,000	1,250			
		chum	380,000	5,800	9,500	4,138	46,762
Kitsumkalum	pilot hatchery	chinook	63,422	713	1,620	593	6,959
Pinkut Cr.	sp. channel & flow control	sockeye	53,000,000	477,000	540,000	225,720	1,398,632
Fulton R.	sp. channel & flow control	sockeye	108,700,000	978,300	1,125,000	470,250	2,913,817
Kitimat R.	pilot hatchery[3]	chinook	117,600	3,528	157,000	70,375	791,995
		sockeye			4,000	1,568	9,722
		chum			158,400	118,800	1,346,400
		pink			10,000	6,000	26,112
		coho			92,000	55,200	357,420
		steelhead			1,000	500	5,150
Bella Coola R.	Japanese hatchery	chum	2,818,400	56,386	180,000	124,740	1,557,738
		steelhead	78,790	788	600	300	3,090
Bear R.	hatchery	pink	1,815,411	50,385	130,000	58,200	240,000
Quinsam R.	hatchery	chinook	1,136,778	34,103	30,000	21,112	171,433
		coho	1,427,233	214,085	162,000	90,296	439,388
		pink	2,072,067	58,298	160,000	48,000	232,800
		steelhead	63,881	916	1,000	500	5,150
Puntledge R.	hatchery	coho	922,865	12,020	126,000	70,230	341,743
		chinook	1,079,652	32,390	151,000	106,268	862,880
		chum	3,327,834	66,557	120,000	52,800	615,754
		pink	631,651	15,791	20,000	6,000	29,100
		steelhead	33,565	1,007	2,756	1,378	14,193
Tsolum R.	satellite hatchery	pink	884,296	22,107	80,000	48,000	232,800
Big Qualicum R.	sp. channel & flow control	chum	61,805,918	403,800	349,000	153,560	1,790,817
	hatchery	steelhead	71,385	2,141	3,200	1,600	16,480
		coho	697,409	139,482	212,000	131,440	639,596
		chinook	4,335,402	130,062	90,000	63,335	514,298
Little Qualicum R.	sp. channel	chum	7,627,000	58,139	360,000	158,400	1,847,261
	hatchery	chinook	1,178,000	35,340	40,000	28,149	228,578
		steelhead	10,876	326	735	367	3,780
Chemainus R.	hatchery	chinook	107,000	3,210	3,000	2,111	17,143
Tlupana In.	Japanese hatchery	chum	8,942,146	178,843	331,200	145,728	1,597,470
		chinook	198,000	2,227	43,200	19,699	224,364
		coho			6,500	3,087	16,315
Robertson Cr.	hatchery	steelhead	97,118	2,914	10,000	9,000	92,700
		coho	1,095,822	164,373	150,000	97,350	543,322
		chinook	9,162,000	274,860	270,000	173,520	1,737,187
Nitinat R.	Japanese hatchery	chum	2,311,624	46,232	403,200	177,408	2,000,098
	hatchery	chinook	90,129	2,704	32,400	17,366	169,030
Slim Cr.	incubation box	chinook	56,000	630	2,880	2,358	19,927
Bowron R.	incubation box	chinook	27,000	304			
Jones Cr.	sp. channel	chum	37,500	750	1,200	522	6,225
		pink	1,600,000	40,000	34,000	16,355	76,667
Birkenhead R.	hatchery	chinook	86,830	2,278	2,916	2,387	20,176
Chilliwack R.	hatchery[3]	chum	845,179	16,904	200,000	86,920	1,037,528
		coho			150,000	87,750	438,862
		chinook			15,100	12,364	104,488
		steelhead			6,700	4,020	41,406
Inch Cr.	hatchery	coho	118,758	2,375	4,100	2,398	11,996
	incubation box	chum	946,705	18,934	80,000	34,768	413,824
	incubation box	chum	235,000	4,700			
Capilano R.	hatchery	chinook	1,321,000	39,630	36,000	26,337	176,556
		coho	828,897	110,634	80,000	35,234	152,332
		steelhead	37,250	766	600	300	3,090
		chum[4]	5,009	100	—	—	—
Indian Arm[5]	pilot hatchery	chinook	192,855	1,157			
	sea pens	coho	50,000	7,500			

Table 4: Juvenile Fish Production from SEP Facilities* in 1981 and Adult Production at Design Capacity

					AT DESIGN CAPACITY		
Project	Type	Species	Juveniles Released	Expected Adult Production	Adult Production (Pieces)	Catch[1] (Pieces)	Catch (Pounds)
Community Development Projects							
Thornton Cr.	hatchery[3]	chum	325,000	5,200	28,800	12,672	142,864
		coho			1,620	695	3,587
		chinook			3,240	1,737	16,903
Bella Bella	hatchery[3]	chum	190,000	2,120	15,650	25,724	321,241
		sockeye			1,340	530	3,318
		coho			540	381	2,483
San Juan R.	incubation box	pink	100	3	—[3]	—	—
		chum	4,300	34	630	277	3,102
		sockeye	25,000	420	335		
		coho	92,500	1,110	12,960	4,536	24,125
	hatchery	chinook	5,600	168	2,560	1,413	13,771
Sliammon R.	Japanese hatchery	chum	953,898	19,078	19,200	8,448	99,668
	hatchery	coho	8,593	1,289	11,750	4,242	19,009
Alouette R.	hatchery[2]	chum	250,000	1,428	21,600	9,387	112,053
		coho			1,080	632	3,160
		chinook			1,080	884	7,472
Nanaimo R.	hatchery[2]	chum	901,000	5,911	12,910	5,680	66,240
		steelhead	37,400	668	410	205	2,111
		chinook	200,838	6,023	6,440	4,532	36,799
		coho	95,400	1,145	3,240	1,806	8,789
		cutthroat			2,240	1,501	15,460
Seymour R.	hatchery[2]	coho	64,000	9,600	10,140	5,932	29,667
		steelhead	7,840	314	1,452	871	8,971
		cutthroat	1,340	335	560	375	3,862
		chum			720	313	3,739
		pink			100	48	225
		chinook			648	531	4,486
Cowichan R.	hatchery[2]	chum	630,000	12,600	56,300	24,772	288,891
		chinook	90,000	2,700	10,800	7,600	61,716
		coho			1,080	602	2,931
Sechelt	hatchery[2]	coho	22,000	3,300	5,065	1,828	8,192
		chum			3,600	1,584	18,691
	sea pens	chinook	12,000	3,960	1,080	790	5,296
Kincolith R.	hatchery[2]	chinook	4,000	120	14,040	4,802	56,373
		chum			4,010	2,141	24,197
		coho			2,340	1,095	7,220
Kispiox R.	hatchery[2]	chinook	67,000	2,010	2,560	937	11,003
		coho	27,550	331	2,160	913	6,016
		steelhead			1,050	525	5,407
Masset							
Yakoun R.	sea pens	chinook	87,000	5,370	6,480	3,110	36,516
King Cr.	incubation box[2]	coho	14,086	1,851	1,620	635	4,163
		sockeye			2,680	1,501	9,306
		pink			300	138	604
Chehalis R.	hatchery	coho	2,992	449	2,160 131,600	1,768 57,193	14,944 682,693
Harrison R.	sp. channel	chum	13,000	104			
	hatchery	chinook	39,200	1,176			
Billy Harris Sl.	sp. channel	chum	1,316,400	10,531			
Little Mountain Sl.	sp. channel	chum	484,200	3,874			
Jimmy Charlie Sl.	incubation pit	chum	4,100	33			
Jonnie Mac Sl.	incubation pit	chum	15,200	122			
Weaver Cr.	stream improvement	coho	366	4			
Nimpkish	hatchery[2]	chum	940,000	18,800	10,800	4,968	58,622
		sockeye	1,500,000 +	19,800	68,600	38,416	241,483
		chinook			2,160	1,469	17,081
False Cr.	sea pens[2]	chinook	12,447	2,384	324	531	4,486
		coho			507	5,932	29,667
		chum			72	313	3,739
		cutthroat			280	0	0
		steelhead			105	871	8,971
		pink			5,000	48	225

Table 4: Juvenile Fish Production from SEP Facilities* in 1981 and Adult Production at Design Capacity

					AT DESIGN CAPACITY		
Project	**Type**	**Species**	**Juveniles Released**	**Expected Adult Production**	**Adult Production (Pieces)**	**Catch[1] (Pieces)**	**Catch (Pounds)**
Small Projects							
Sachs Cr.	pilot hatchery[6]	pink	53,355	1,334	—[3]	—	—
		coho	—	—	7,500	3,360	22,218
Vancouver Bay	incubation box[7]	chum	750 +	15	4,000	1,760	20,768
		pink			15,000	11,100	53,835
Zymoetz R.	pilot hatchery[2]	chinook	18,800	470	700	256	3,007
		steelhead	—	—	130	65	669
Lake Enrichment[8]							
Great Central L.	fertilization	sockeye	10,236,000	460,620	1,797,000	1,096,170	5,371,233
Henderson L.	fertilization	sockeye	1,356,000	61,020	572,300	349,103	1,710,605
Hobiton L.	fertilization	sockeye	524,000	23,580	172,900	105,469	516,798
Kennedy L.	fertilization	sockeye	841,000	37,845	600,000	366,000	2,159,400
Lowe L.	fertilization	sockeye	220,000	9,900	307,600	120,579	747,591
Awun L.	fertilization	sockeye	159,000	7,155	255,500	143,080	887,096
Eden L.	fertilization	sockeye	267,000	12,015			
Ian L.	fertilization	sockeye	—[9]				
Bonilla L.	fertilization	sockeye	106,000	4,770	43,500	17,052	105,722
Devon L.	fertilization	sockeye	52,000	2,340	85,000	33,320	206,584
Kitlope L.	fertilization	sockeye	133,200	5,994	653,400	256,133	1,588,023
Curtis L.	fertilization	sockeye	225,000	10,125	130,000	50,960	315,952
Research Production							
Rosewall Cr.	hatchery[10]	steelhead	40,493	1,215	—	—	—
Provincial SEP-Funded							
Abbotsford	hatchery[2]						
Coquihalla R.		steelhead	128,297[11]	2,568	3,800	3,390	34,917
Alouette R.		steelhead	53,731[11]	1,037			
Silverhope R.		steelhead	30,000	300			
L. Campbell R.		steelhead	9,284[11]	139			
Squamish R.		steelhead	29,300	293			
Squamish R.		cutthroat			5,500	3,685	37,955
Surrey	rearing ponds[12]						
L. Campbell R.		steelhead	11,212	336	400	240	2,472
Nathan & West Cr.		cutthroat	12,388	372	3,000	—	—
Loon Cr.	hatchery						
Deadman R.		steelhead	39,058	1,562	1,200	4,800	49,440
Bonaparte R.		chinook	55,613	2,225	1,500	1,007	8,181
Saanich	fry stocking						
Sandhill Cr.		cutthroat	21,448[11]	709	3,500	4,050	41,715
Colquitz Cr.		cutthroat	8,598[11]	602			
Oyster R.		cutthroat	10,776[11]	1,018			
Black Cr.		cutthroat	13,051[11]	798			
Fulford Cr.		cutthroat	17,259	1,726			
Cowichan R.	hatchery	steelhead	9,385	375	2,000	1,000	10,300
Public Involvement Projects[13]							
Granite Bay	incubation box	pink	65,000	1,820			
Memekay R.	incubation box	coho	2,850	34			
Craig Cr.	short-term rearing[14]	coho	10,000	1,500			
Beach Cr.	short-term rearing	coho	10,000	1,500			
Head Waters #1 Supply	incubation box	coho	80,000	960			
Heber Cr.	short-term rearing[15]	coho	9,000	114			
Goodspeed Cr.	incubation box	coho	1,620	19			
Drew Harbour Cr.	incubation box	chum	25,000	400			
	incubation box	coho	20,000	420			
Waterfall Cr.	incubation box	chum	25,000	200			
Big Goose Cr.	incubation box	chum	800	6			
	incubation box	pink	5,000	125			
Clint Cr.	incubation box	chum	74,800	598			
Powrivco Cr.	incubation box	chum	30,000	240			

Table 4: Juvenile Fish Production from SEP Facilities* in 1981 and Adult Production at Design Capacity

					AT DESIGN CAPACITY		
Project	Type	Species	Juveniles Released	Expected Adult Production	Adult Production (Pieces)	Catch[1] (Pieces)	Catch (Pounds)
Public Involvement Projects[13]							
Fairfax Cr.	incubation box	coho	24,000	288			
Kloiya Cr.	incubation box	chinook	930	18			
Salmon R. & Tappen Cr.	incubation box	coho	5,500	66			
Hastings Cr.	incubation box	steelhead	1,250	8			
Glenlion R.	incubation box	pink	31,500	788			
Nadu Cr.	incubation box	coho	8,825	106			
Salmon R. (Pr. George)	incubation box	chinook	7,000	210			
Noble Cr.	incubation box	coho	13,500	162			
Shawnigan L.	incubation box	chum	8,200	66			
		coho	6,033	72			
Sooke R.	incubation box	coho	110,000	1,320			
	incubation box	chinook	34,000	1,020			
Veitch Cr.	incubation box	coho	1,500	18			
De Mamiel Cr.	incubation box	coho	32,440	389			
Pachena R.	incubation box	coho	17,840	214			
Hyde Cr.	incubation box	chum	3,000	24			
Wakefield Cr.	incubation box	coho	18,000	216			
Chaster Cr.	incubation box	chum	100	1			
Cypress Cr.	incubation box	coho	20,000	240			
Rodgers Cr.	incubation box	coho	16,250	195			
Mossom Cr.	incubation box	chum	1,000	8			
Noons Cr.	incubation box	coho	10,500	258			
Flume Cr.	incubation box	chum	1,000	8			
Deserted R.	incubation box	coho	10,000	120			
Salmon R.	incubation box	coho	1,000	12			
Haslam Cr.	incubation box	coho	3,000	28			
Louis Cr.	incubation box	coho	1,500	18			
Tranquille Cr.	incubation box	coho	3,000	36			
Bessette Cr.	incubation box	coho	800	10			
Hartley Bay Cr.	incubation box	coho	6,000	72			
Greg Cr.	short-term rearing	coho	45,000	945			
Mohun Cr.	short-term rearing	coho	25,000	525			
Casey Cr.	short-term rearing	coho	10,000	210			
Fishways[16]							
Embley	vertical slot	pink			210,000	122,220	504,000
Kakweiken	vertical slot	pink			100,000	58,200	240,000
Koksilah	vertical slot	chum			2,000	880	10,263
		chinook			500	352	2,862
		coho			2,000	1,115	5,421
		steelhead			2,000	1,000	10,300
Read	steep-pass	pink			3,200	1,862	7,681
		chinook			16,000	10,880	125,325

[1] Catch at design capacity includes sport, commercial and native food fish catches.

[2] Capacity figures are unavailable.

[3] Depending on conditions or strategies, species may come into production at different times.

[4] The chum release at Capilano was a small experimental group; there are no plans for chum in the future.

[5] Operations discontinued.

[6] Sachs Creek pilot hatchery releases juvenile pink salmon in the odd year and juvenile coho in the even year.

[7] Vancouver Bay project was affected by severe flooding, hence the low number of juveniles released.

[8] 1981 juvenile releases are from 1979 brood year stocks. When applied to lake enrichment, "at design capacity" figures refer to the carrying capacity of the lake.

[9] Insufficient sample.

[10] Research facility; no "at design capacity" data.

[11] Juveniles released are an accumulation of 1980 and 1981 brood years.

[12] Wild fry were trapped from these creeks and reared in the Surrey rearing ponds.

[13] It is difficult to estimate "design capacity" due to the continually evolving nature of these projects.

[14] Fry transplanted from Quinsam hatchery.

[15] Fry salvage.

[16] "At design capacity" when applied to fishways, refers to what the river will produce as a result of the fishway. Adult production is from the EPIC database; catch is calculated using production model standards.

Fisheries and Oceans
Pêches et Océans

Province of British Columbia
Ministry of Environment

Salmonid Enhancement Program
Department of Fisheries and Oceans
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Annual Report 1981

Salmonid Enhancement Program

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Director's Report

As the executive director of the federal/provincial Salmonid Enhancement Program (SEP), I welcome this opportunity to present a review of our activities in 1981.

The Salmonid Enhancement Program (SEP) now is five years old. As the Program matures, its highlights change. Last year was characterized by the construction of major facilities. This year, 1981, is one of record egg-takes and increasingly large returns of salmon.

Nitinat hatchery, in its first year of full operation, set a Canadian egg-take record. Expecting to take 10 million chum eggs, hatchery staff took advantage of the large number of adults returning to spawn and filled the hatchery to capacity with 28 million chum eggs and half a million chinook eggs.

Almost four times the expected number of eggs were taken for Pallant Creek hatchery, on the Queen Charlotte Islands. With 8.3 million chum eggs incubating as of December 31 this year, the hatchery is operating at full capacity for the first time. Chum and coho egg-take targets, of 4.2 million and 400,000 respectively, were met in Chilliwack hatchery's first year of operation.

Although SEP cannot take full credit for facilities constructed before 1977, these projects are good indicators of the potential production of SEP facilities. For example, the spawning channels at Fulton River and Pinkut Creek contributed 52.2 percent of the total sockeye harvest for the Skeena River. The total catch of 1.38 million sockeye was the largest on record.

Returns to the facility on the Big Qualicum River also serve as production indicators. Prior to any coho enhancement on the Big Qualicum River, the historical escapement averaged 3,500 spawners. In 1981, more than 65,000 fish returned, an all-time record for this river. It is estimated that "BQR" contributes another 100,000 coho to the sport and commercial fisheries.

Big production, however, is not the whole story of SEP. Throughout the province, dozens of small projects are operated by volunteers. Corporate support for these projects is also growing; B.C. Forest Products, Canadian Forest Products, Tahsis Mines, MacMillan Bloedel, and The Vancouver Sun, to name but a few, have supported enhancement projects this year.

The Vancouver Sun "project" is aimed at involving Lower Mainland schoolchildren in salmonid enhancement. It has been a tremendous success.

In addition to raising funds for SEP, the newspaper has done more than its share in informing the public about the importance of the salmonid resource and in encouraging public involvement.

SEP's community development program provides employment opportunities in underdeveloped areas of the province. SEP contracts community groups (many are Indian bands) to carry out a variety of projects, ranging from stream clearance and surveys to the construction and operation of hatcheries. In 1981, there were 14 such projects, employing 135 people on a full-time or part-time basis.

An evaluation of the community development program concluded that it is one of the best economic development programs for native people.

In an era when cost overruns and delays are commonplace. it is gratifying to note that the major projects under construction in 1981, including facilities at Kitimat, Chehalis, Tenderfoot and Inch, are on schedule and within budget.

Phase I of SEP will end in March, 1984. It is important to carry out some development work, such as reconnaissance and feasibility studies, prior to the end of Phase I, so that momentum is maintained into Phase II. The funds received in 1981 ($1.5 million) to carry out this work were less than hoped for; however, we are confident that much was accomplished with the funds provided.

Late in the year, Phase II enhancement opportunities were identified. In 1982, this list will be further refined.

SEP is, of course, only one component of the Department's fisheries management picture. The Program is closely allied with Field Services Branch, which manages all fisheries on the Pacific Coast, and with the Fisheries Research Branch. We in SEP value their close cooperation and support.

The provincial government also plays a valued role in SEP, concentrating on the enhancement of sea-run trout, the steelhead and cutthroat. We welcome its continued support and participation.

SEP's two advisory groups, the Salmonid Enhancement Board and the Salmonid Enhancement Task Group, continue to provide valuable input into program direction.

How does the SEP measure up?

SEP isn't a government program that, once started, never stops and is never questioned. SEP is under constant review, and its progress is measured against the targets established in 1977. Phase I of SEP ends in 1984, and unless it has been successful, that's the end of SEP. There is no Phase II unless Phase I measures up.

SEP has been adversely affected by the impacts of inflation and extending the Program to seven years from five. These factors have "eaten into" SEP's allotment of $150 million dollars over five years. However, an evaluation of SEP in 1980 showed the Program is doing proportionately better than expected--with fewer dollars. Inflation and "extension" have had major impacts on all five main objectives. Nevertheless, SEP has done well, considering these constraints.

SEP generates money

Originally, the benefit/cost ratio of SEP was targetted at 1.5:1. While individual projects may have higher or lower benefit/cost ratios, the average, up to 1981, now stands at 1.3:1.

SEP represents the investment of funds in enhancement facilities and projects that will produce benefits in terms of increased catches for commercial, recreational, and native food fishermen. Because of the time required to build enhancement facilities and multi-year production cycles of salmon species, these benefits may not accrue for many years. SEP is therefore evaluated as an investment project in which future returns are compared to total expenditures. The economic benefits of SEP relative to the costs are equivalent to investing money in a savings account at a bank that pays 26 percent, given today's inflation rate of 10 percent.

More jobs

At the outset of the Program, a target was set of 458 person-years[1] of new employment in the construction and operation of new facilities.

In 1981, SEP had exceeded, by 36 percent, this employment goal.

This excellent performance is due, in part, to the shifting of emphasis from large-scale projects to smaller-scale projects, which are more labor intensive. A second factor is the extension of the Program to seven years from five. This meant adding person-years to the original estimates for operating the facilities.

Regional developments

Many of SEP's major facilities and most of the community development projects are located in areas of high unemployment and little or no economic development.

There are three other factors affecting performance in this account, in addition to the inflation and extension impacts already discussed. First, the shift in Program emphasis to chinook enhancement also affected performance in this account. Chinook are caught and processed mainly on Vancouver Island and the Lower Mainland, which are not considered undeveloped regions.

Second, most of the earlier projects were developed in the south coast of B.C., where more enhancement opportunities were ready to go. Also, there was a conscious decision to trade off some regional development objectives in order to improve the economic performance of SEP. (Projects in remote and northern areas of the province are more expensive to develop and operate.)

It was planned that, by the end of Phase I, about $200 million in benefits would accrue to the less developed regions, which are collectively defined as the area north of a line from Powell River to Bamfield. These benefits are found in the harvesting, processing and employment sectors. So far, about $88 million in benefits have been directed to this region.

Native people benefit, too

Since SEP's inception in 1977, some 266 person-years of employment for native people have been created, and about 32 of those are permanent jobs. Most of these were created in areas where unemployment ranges from 40-80 percent.

The number of permanent jobs created is less than originally targetted because the construction, and in some cases, the operation of SEP facilities, is contracted out to the private sector. SEP has no control over who the contractors hire.

The community development program, which generates many of the native Indian benefits, was evaluated in 1981. The report noted that "the [community development] program has been satisfying both to project employees and to the communities at large. The program's concentration on long-term job creation revolving around preservation of a highly-valued resource provides direct economic benefits, personal and community satisfaction, and a sense of working for the future."

Saving fish and habitat

This is an admirable goal, but SEP has experienced difficulty in trying to pin it down. Basically, every proposed SEP project is evaluated according to its probable impact on the environment and the salmonid resource.

It has become evident that the manageability of enhanced stocks is one of the key criteria in enhancement. In 1981, SEP funded a number of studies to examine several aspects of this very important question.

---

[1] a person-year is defined as one year of work for one person.

Tallying the score

Of course, the means to achieve these social and economic goals is through fish production. How does SEP stand here?

By 1981, SEP had achieved a production capacity of 35.9 million pounds, or about 72 percent of the target of 50 million pounds by the end of Phase I. However, the mix of production for each species has been modified in response to changing needs and opportunities.

Sockeye production is close to 70 percent greater than the original target, largely because of the success of the lake enrichment program.

In contrast, chum production is only about 45 percent of the initial target. Potential chum projects were dropped when funding for new projects was reduced and because market demand for chum had fallen severely. There are also problems regarding when and where to harvest chum salmon. Fisheries managers are reluctant to add an enhanced stock into complicated mixed stock fisheries, in which most chum are caught. One answer to this problem would be to harvest the chum closer to their home streams, when they aren't mixed with other stocks. However, the flesh quality of these fish deteriorates as they return to the stream to spawn.

Chinook salmon production is about 70 percent of target because enhancement opportunities in the Fraser River often are not economical, or the fish produced would not be manageable without some negative impacts on other stocks. Also, enhancement technology is relatively expensive and in its infancy for some chinook stocks, such as those in the upper Fraser, which may spend up to two years in fresh water.

Coho production is about 80 percent of target because the enhancement requirements and problems of this species are similar to that of chinook.

Pink salmon production is expected to be below the original target of 3.8 million pounds, mainly because there is no proven enhancement technique for this species.

By 1984, steelhead and sea-run cutthroat production is expected to be about twice that of the original target. The target of 200,000 pounds per year, set in 1977, was based on the current enhancement techniques known at the time. These included hatchery rearing, an expensive procedure for steelhead, because they may require two years in fresh water before migrating to sea. Now, however, the more recent technique of releasing unfed fry into barren streams or streams of low productivity seems to be reasonably effective and significantly less expensive than any other enhancement technique for steelhead.

The 1981/82 expenditures on salmonid enhancement were $32,753,000. This amount consisted of $26.9 million of federal SEP resources (out of the $150 million seven-year total), $4.6 million provided from other DFO funds to operate pre-SEP facilities, and $1.25 million from the Province of B.C.

At the end of the 1981/82 fiscal year, approximately $109,418,000 of the total $157.5 million total Phase I federal and provincial SEP budgets had been spent. Over the next two years, the balance will be expended.

Preparing for Phase II

In addition, 1981/82 marked the beginning of the planning and development work for Phase II.

The shape of SEP in Phase II is being determined now. In 1981, in a major effort toward planning Phase II, all possible enhancement opportunities were identified. Most of the list of projects came from extensive surveys undertaken by SEP in Phase I. Fishery officers and Fish and Wildlife Branch staff, because of their familiarity with local conditions, provided valuable suggestions. The public, including sport and commercial fishermen, also contributed suggestions, and these have been included in an initial list of 510 opportunities.

Over the next 18 months, this list will be constantly refined as new information comes to light. It will form the backbone of the Salmonid Enhancement Program in the next phase. The features of the Program will be determined by the mixture of the types of projects and their locations. The character of SEP will be formed, in part, by what the public wants the next phase to be. It may look a little different from SEP's Phase I, but you will see a family resemblance!

N.W. Falkner, Ph.D.
Executive Director, SEP

South Coast (Mainland)

Capilano Hatchery

Capilano hatchery is located in North Vancouver, just below Cleveland Dam, approximately five kilometres upstream from the mouth of the Capilano River.

Hatchery Facilities

The hatchery was constructed to maintain and enhance the populations of coho and steelhead, which were prevented from reaching their normal spawning areas behind the Cleveland Dam. Adult handling facilities at the hatchery include a river barrier, fishways, a trapping and brailing system, two Burrows-type adult holding/juvenile rearing ponds, and two circular fibreglass tubs. Juvenile rearing facilities include 10 standard Burrows ponds and 20 rearing troughs. Incubation facilities include Heath tray stacks and freestyle boxes.

A pipeline from Capilano Lake supplies surface water to the hatchery. Groundwater which can be heated to 20°C is also available for incubation and rearing.

Capacity

The hatchery was designed and built in 1971 for the annual production of one million coho, 350,000 chinook and 50,000 steelhead. However, improvements in the rearing facility and changes in production goals have resulted in an increase in production to 1.5-2.0 million chinook and 500,000-one million coho per year.

In 1981, the possibility of further expansion was examined. One of 10 gravel filters beneath the rearing ponds was converted to "raceway" rearing ponds for rearing additional chinook fry. When completed, this conversion could increase chinook production by approximately 50 percent, or allow for two-year rearing of steelhead trout. The hatchery also has the capacity to incubate additional coho for transplant into the upper watershed, and chinook and coho for transplant to other streams.

In 1981, the hatchery released 1.3 million chinook, 565,000 coho and 24,000 steelhead smolts and 5,009 juvenile chum into the Capilano River. In addition, 265,000 coho and 15,000 steelhead were planted in the upper Capilano, and 200,000 chinook presmolts were transplanted into the Indian River.

The Capilano hatchery continued to supply the Sechelt Indian Band with fish (21,000 coho and 21,000 chinook) for its net pen operation. The False Creek net pens also received 16,000 chinook smolts from Capilano. The hatchery also donated fish for research to the Department's West Vancouver lab, Simon Fraser University, University of Victoria, and consultants.

The distribution of salmon eggs during 1981 included 170,000 coho eggs for the Public Participation Program and 50,000 coho eggs for Tidal Rush Marine Farms.

Operations

Two major research studies were undertaken at Capilano in 1981: the first of a two-year "size-and-time-of-release" study, plus a density-dependent rearing study on chinook

Capilano hatchery staff make preparations to transfer Capilano-brood chinook to the Indian River.

smolts. A variety of short-term studies were also carried out to evaluate the use of the filter chambers for fish rearing.

Very low water in the river during July and August resulted in an accumulation of significant numbers of chinook and coho off the mouth of the river. The escapement of salmon back to the river in September and October was sufficient for hatchery requirements, and a surplus of coho was declared. In 1981, 23,000 coho and 1,200 chinook returned to the hatchery.

Extensive flooding in the fall of 1981 caused heavy erosion on the Capilano River. Rip-rap protecting the hatchery slipped into the stream, leaving the rearing ponds exposed and vulnerable to high water. To prevent flooding of the hatchery complex, approximately 300 cubic yards of rock was placed along the bank.

Tourist Attraction

Each year, the hatchery plays host to almost 300,000 visitors. Live fish in the fishway and in adult holding ponds adjacent to the viewing room are major attractions.

Contact: Eldon Stone, Stock Enhancement Officer, Colin MacKinnon, Unit Head, Enhancement Operations; John Beyer, Senior Engineering Technician, Engineering.

Seymour River Hatchery (BCIT)

This BCIT salmonid enhancement project is on the Seymour River, immediately below the Rice Lake Dam in North Vancouver.

The main objectives of this project are to enhance chinook, coho, cutthroat and steelhead trout in the Seymour River and to provide BCIT students with hands-on experience in fish culture and enhancement techniques.

The project employs a full-time hatchery manager and a part-time assistant. Additional help is provided on a volunteer basis by students in the Fish, Wildlife and Recreation program at BCIT.

In 1981, fish culture activities continued. Various broods of various species were coded-wire tagged. Summer and winter runs of steelhead, chinook, coho and cutthroat were among the species worked with. Anglers on the Seymour River have reported significantly increased returns of coho and winter-run steelhead.

In 1982, the continued operation of this facility will be augmented by: collecting baseline watershed data to develop fry-stocking strategies, supporting student projects that involve experimentation with various incubation systems and species, and evaluating stream improvement techniques.

Contact: Chris de Hrussoczy-Wirth, Project Coordinator, Special Projects.

Public Participation Projects

Contact: Bryan Allen, SEP Community Advisor, New Westminster.

Capilano Rod and Gun Club

Early in 1981, several junior Club members conducted an inventory of sea-run cutthroat in Brothers Creek.

In addition, one Club member helped to remove the Louis Pool obstruction during the summer; this low-water obstruction was one of the factors leading to a severe poaching problem on the creek.

Buntzen Bay Residents' Association

During the summer, the Buntzen Bay Residents' Association (in Indian Arm) constructed and installed a 50,000-egg incubation box for coho on Richards Creek. In the fall, 25,000 coho eggs (Capilano origin) were planted; resultant fry will be released into the Creek in 1982.

Association members also dug a small rearing pond.

Eight people were involved with this project in 1981.

North Shore Rod and Gun Club

This Club assisted with a pilot program (along with the Capilano Rod and Gun Club) to capture cutthroat brood stock from north shore creeks for the Seymour River hatchery, operated by B.C. Institute of Technology students. Unfortunately, labour disputes disrupted operations at the hatchery; consequently, it was extremely difficult to take advantage of the opportunity to capture sea-run cutthroat before they had spawned.

In 1981, approximately 15 people were involved.

In 1982, the Club plans to construct a fishway for installation on McKay Creek.

Sierra Club of B.C.

Approximately five members of the Sierra Club cleaned up Mosquito Creek in the spring.

Max Tscharre

Fishery officer Max Tscharre headed a group of ten volunteers in removing a long-standing low water obstruction on the Seymour River in the spring.

North Shore Fish and Game

During the spring, Club members conducted a bio-survey on McKay Creek. Later in the year, they planted 25,000 Capilano coho eggs in an upwelling incubation box. Some 20,000 fry were produced and released into the upper watershed.

Approximately 15 people were involved in this project in 1981.

Jan Carleson

In 1981, Jan Carleson converted a fibreglass tank into a "Netarts" incubation box, with a capacity for 300,000 eggs. Mr. Carleson had planned to stock his incubation box with 25,000 chum eggs from Worth Creek; however, December floods prevented this.

Brian Waite

Brian Waite constructed and installed a 50,000-egg incubation box on his property in Port Moody. The box was stocked with 30,000 coho eggs from Capilano hatchery. He released more than 9,000 fry and fingerlings into Noons Creek in the spring and reared another

3,000 fingerlings in a small rearing trough on his property. As the rearing capacity was limited, he decided to release fish into the creek as the fish grew. He reared 1,500-2,000 fish to the smolt stage before releasing them.

In 1982, Mr. Waite plans to incubate 20,000 coho eggs and to rear the resultant fry to the smolt stage. He also plans to tag them prior to release.

West Vancouver School District

The Alouette River Correctional Center built an incubation box for the West Vancouver School District. The box was installed on Rodgers Creek and stocked with 25,000 coho eggs from the Capilano River. Several schools were involved in the operation of the box. By the spring of 1981, 14,000 fry had been released along the creek by students from two elementary schools.

This project comes under the wing of the "Save the Salmon" program.

The Vancouver Sun

In May, the Vancouver Sun, the Pacific Salmon Society and SEP initiated a stream and salmonid enhancement educational program ("Save the Salmon") with the North and West Vancouver School Districts.

During the year, The Sun raised funds for many stream enhancement projects on the North Shore and developed plans for constructing a mini-hatchery for chinook at the North Vancouver Outdoor School near Squamish.

Hillside Rod and Reel Club

In 1981, the 25 Club members built and installed an incubation box on Cypress Creek, a once-productive salmon stream. Approximately 25,000 coho eggs from Capilano brood stock were planted in the box; approximately 20,000 fry were produced and later released into Cypress Creek.

Although this project has had problems with flooding, freezing and vandalism, the Club hopes to solve these problems and continue to produce fish in the years to come, as well as to improve the spawning grounds for returning fish.

This project was incorporated into the "Save the Salmon" program in 1981.

Squaretailers' Rod and Reel Club

In 1981, Club members constructed and installed an upwelling incubation box for coho on Hastings Creek, a tributary of Lynn Creek in North Vancouver. The box was planted with approximately 35,000 coho eggs, which were obtained from Capilano hatchery. However, a sewage fungus originating in the water source suffocated the majority of the incubating eggs, and only 1,000 survived to the fry stage. These fry were released into Hastings Creek.

The water problem has been tackled, and the 14 Club members are looking forward to continuing this project.

Bowen Island Rod and Gun Club

This club plans to build a small hatchery for coho and chinook on Terminal Creek. Production targets include 25,000 coho eggs and 25,000 chinook eggs. At the end of 1981, the hatchery was still in the design stages, although the site was moved to another location on Terminal Creek.

In 1981, the Club released 23,000 coho of Capilano origin into Grafton Lake and Terminal and Killarney Creeks. In future, the Club plans to rear the coho for a month after hatching, and then release the fry into McKinney Lake. In 1982, the Club hopes to obtain some 40,000-50,000 eyed eggs from Capilano hatchery for this purpose.

Plans to rear chinook in pens for three months (to smolt stage) and then release them directly into a freshwater/saltwater lagoon have been postponed because of the unavailability of chinook eggs from Capilano hatchery.

Approximately eight people were involved with this project in 1981.

School District #48

In the spring, elementary school students in District #48 removed debris from Loggers Lane Creek and then added spawning gravel to selected areas of the creek.

In the fall, the students used fire hoses to clean the gravel.

Although the project had been granted permission to transplant 25,000 coho eggs from the Mamquam River, only 2,500 eggs were actually taken in a demonstration egg-take. Approximately 40-50 natural spawners utilized the new gravel, making a transplant unnecessary.

Approximately 90 students were involved with this project in 1981.

Eagle Run Residents' Association

In 1981, the Association, assisted by people from the Community Service Work Order program, removed ten truckloads of debris along 500 metres of Dryden Creek in Squamish. Silt accumulation in the creek was mainly due to two floods in 1981. The 24 members also placed rock in certain areas of the creek. The gravel and shot rock for the project was donated by a local contractor.

Coast Steelheaders

This is the second year of a five-year project to enhance steelhead in the Squamish River system, the group assisted the provincial Fish and Wildlife Branch in capturing brood stock for the Abbotsford trout hatchery. Approximately 16 people were involved with this project in 1981.

Elphinstone Secondary School

This Gibsons school is attempting to restock chum runs in Chaster Creek and to raise public awareness of the salmonid resource.

In 1981, 20 grade eight students built and installed a 50,000-egg upwelling incubation box on Chaster Creek and stocked it with 20,000 chum eggs from Roberts Creek brood stock. A flood in December caused a landslide upstream of the box. The box was silted under and the intake was washed out. All the incubating eggs were killed.

In 1982, the box will be moved upstream, to a more stable area, before the eggs are planted.

Gibsons Wildlife Club

In 1981, 15 Club members repaired an existing concrete fishway on Wilson Creek to aid the coho and chum upstream migration. They also constructed a 50,000-egg incubator, which will be stocked with coho eggs in 1982, if stock numbers permit.

BCIT/Gibsons Alternate School/L & K Lumber

B.C. Institute of Technology operates incubation boxes for chum on Ouellette Creek near Gibsons.

BCIT students had planned to transplant 100,000 chum eggs from Roberts Creek. However, scheduling problems on the part of the institute, plus recurring high water, hampered the students' efforts.

Later in the year, L & K Lumber took over operation of the project. However, BCIT will remain involved with the stream work.

In 1981, approximately five people were involved with this project.

Sechelt Elementary School

Students installed an incubator in an old side channel of Angus Creek in 1980. However, because of the lateness in completing the box, it was only possible to stock the box that year with 5,000 chum eggs. Unfortunately December floods damaged the water supply line, resulting in a loss of the eggs.

The students spent much of 1981 renovating and rebuilding their project--the waterline was reestablished and buried, and a desilting basin was installed.

Sechelt Rod and Gun Club

Club members rebuilt and relocated the incubation box on Flume Creek, as well as improved the waterline that was damaged by the flood in December 1980.

The box was stocked with 25,000 chum eggs of Roberts Creek origin in November, 1980, but the silt caused by the floods killed the majority of the eggs. Only a handful of fry were released in the spring of 1981.

Club members also blasted the obstruction at the mouth of the creek. It should now be possible for chum to gain access to the creek at very high tides.

Club members also installed, on Wakefield Creek, an incubation box for coho of Mixall Creek origin. Approximately 18,000 fry (90% survival rate), hatched successfully from this box. The coho fry were successfully transplanted above the large falls on Wakefield Creek.

In 1982, a 25,000 egg-take from Mixall Creek brood stock for incubation at the Wakefield Creek box has been proposed.

Madeira Park Elementary School

Thirty elementary students installed this box on Haslum Creek, south of Pender Harbor. Approximately 5,000 chum eggs and 5,000 coho eggs of Anderson Creek origin were stocked in the box. Upon swim-up, the fry were transferred back to Anderson Creek for release. Lack of proper enumeration precluded an analysis of last year's work.

Pender Harbor Wildlife Association

In the spring, Association members assisted a local contractor in removing debris from Sakinaw Lake. The debris was threatening to block the fishway.

Native Environmental School

During 1981, Tso-nye School constructed and installed two incubation boxes on Deserted River. One box, planted with 25,000 chum eggs, was located on Tsuwadi Creek. The other box, filled with 18,000 coho eggs, is situated on the school water supply near the camp.

All the chum eggs were lost when the waterline was destroyed in a flood. The waterline was ripped out by logging debris. The coho eggs had a survival rate of 95 percent to the hatched stage.

George Pearkes Secondary School

About fifteen students at this school have been working with chum stocks of Hyde Creek. Unfortunately, of the 16,000 chum eggs planted in the school's incubation box in October, 1980, only 19 percent survived to the fry stage in 1981. The environmental problems associated with Hyde Creek, such as discharges of silt and mud, floods and freeze-up, were responsible for only a partially-successful hatch. Nevertheless, the project has succeeded in raising the awareness of both the students and the creekside residents to the problems.

During the summer, the incubation box was moved to another location on Hyde Creek where it could be closely supervised. Later in the year, 17,000 chum eggs were planted in the box; resultant fry will be released into Hyde Creek in 1982.

Montgomery Junior Secondary School

This school project was initiated to assess the water quality of Laurentian Creek, to clean up the environment surrounding the school, and to maintain the quality of existing life in the stream.

Under the supervision of teacher Mary Green, approximately 65 students conducted a stream inventory, installed an incubation box for coho on the stream, created a natural redd, and removed a major log barrier.

The students planted 100-150 coho eggs from Alouette River brood stock in their incubation box; egg-to-fry survival was 65 percent.

In the fall, 5,000 coho eggs were planted into the school's incubation box; resulting fry will be released into an upper area of Laurentian Creek.

The students also produced a research booklet entitled "Phase II of Monty's Salmonid Enhancement Program," a natural follow-up to their Phase I report.

False Creek Sea Pen Rearing (BCIT)

This project, located on Granville Island in False Creek, is operated by B.C. Institute of Technology students enrolled in the two-year Fish, Wildlife and Recreation program. The students rear chinook in sea pens, conduct small-scale experiments and coordinate a children's fishery for pen-reared chinook. In 1981, the project employed a full-time manager and a half-time assistant. Three other BCIT students were also employed on a part-time basis.

The crew released 12,447 (1979 brood) chinook yearlings (21.5 cm in length, 136 grams in weight) for the 1981 children's fishery, held from May 30 to June 7 in Alder Bay. Approximately 2,000 eager young fishermen captured about 7,200 chinook yearlings. At least 4,000 children and adults attended the fishery, although not all participants caught fish. The average angler was 9-10 years old and fished 3-10 times per year, compared with only once or twice in 1980. This may indicate that the children's fishery is initiating more fishing by children in urban areas.

The 1981 children's fishery at False Creek attracted about 4,000 people.

Of the 5,000 chinook yearlings escaping capture, approximately 1,500 are expected to return as adults to Capilano hatchery. Survival rates of these chinook yearlings are expected to be better than releases of 90-day smolts.

When BCIT students conducted growth experiments during the rearing period of the chinook, they found that high rearing density appears to depress growth and increase the incidence of disease. In another experiment, there was no apparent difference found in growth of fish fed moist diet versus dry diet.

In September, 16,100 chinook fingerlings (1980 brood) were brought to the False Creek pen rearing site from Capilano hatchery. From September to the end of December, the chinook grew from a weight and length of 15 grams and 12 centimetres to 56 grams and 16 centimetres. During this time, growth experiments were again conducted to test the difference in growth when feeding the fish with moist diet compared with dry diet.

For the first time, cutthroat were brought to False Creek for rearing. In October, the 1,440 17-gram cutthroat did not appear to acclimatize very well to salt water at this size and seemed very skittery.

This project will be continued annually at its permanent site at Granville Island. Management of the project will be combined with the Seymour River hatchery, which is also administered by BCIT. Student experiments at the False Creek facility may be expanded to include rainbow trout culture.

Contact: Linda Thorson, Project Coordinator, Special Projects.

Indian River Feasibility

In 1981, a potential hatchery site was located on the Indian River, approximately 2 km upstream from Hixon Creek. Topographical mapping and limited hydrological studies have been completed in preparation for preliminary design of a multi-species hatchery complex.

A groundwater drilling program was undertaken in the spring of 1981--two test production wells adjacent to the site were drilled. The water quality (high iron content) was unacceptable for fish culture purposes; as a result, a further groundwater exploration program was undertaken in the fall. The second program consisted of drilling a number of exploration holes downstream of the original drill sites. In addition, thermographs were installed in Indian River and Forestry Creek to monitor the temperature of the surface water. Although the water quality data have not been fully analysed, it appears that Indian River is suitable as a groundwater source for an enhancement facility.

Preliminary bioengineering design data have been established and biocriteria estimates have been developed to allow preliminary layout of a facility to produce 50,000 chinook, 100,000 chum, 50,000 coho, 200,000 pink, 1,000 steelhead, and 10,000 cutthroat adults. An estuarine pen-rearing facility for chum is also being considered. This pen-rearing facility will not be used for coho, as results from the 1980 saltwater rearing pilot program indicated that summer temperatures were too high for rearing coho.

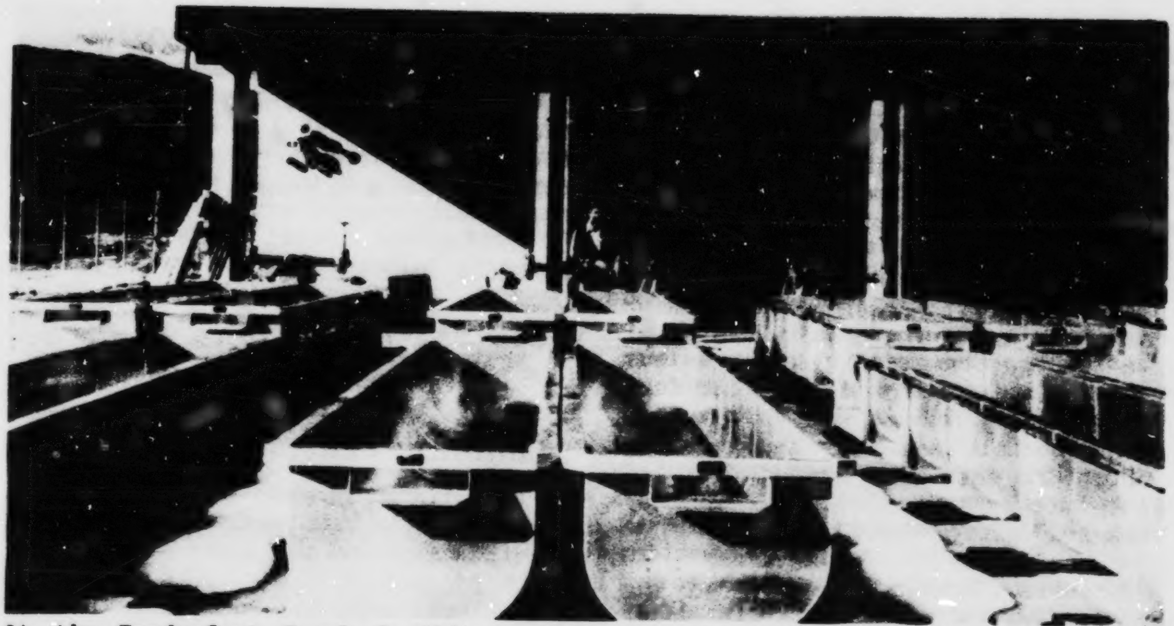
Although this facility would not be built until after 1984 (i.e. in Phase II) and the desirability/feasibility of such a facility has yet to be resolved, it is proposed to proceed with a preliminary design for submission to the Treasury Board for program approval.

Contact: Otto Rapp, Senior Project Engineer, Engineering; Bruce Shepherd, A/New Projects Coordinator, Enhancement Operations.

Tenderfoot Creek Hatchery

The Tenderfoot Creek hatchery, located 16 kilometres north of Squamish, is designed to enhance coho, chinook and steelhead stocks in the Squamish-Cheakamus River system and tributaries in the area surrounding Tenderfoot Creek and Mosley Lake. Construction of this facility will be completed in March, 1982.

Production targets at this hatchery are 75,000 coho eggs, 232,000 chinook eggs, and 140,000 steelhead eggs. The eggs will be incubated in standard Heath tray arrangements, and initially, the fry will be reared in aluminum Capilano-style troughs. Chinook and coho will be transferred to gravel rearing channels for further rearing.



At the Tenderfoot Creek facility, coho, chinook and steelhead fry are to be reared initially in Capilano-style troughs; chinook and coho will be transferred to gravel rearing troughs for further rearing.

Coho will be overwintered and released in June, at a 25-gram size. Chinook will be released as fry of the year, at five grams, while steelhead will be released as fry of the year at 0.5 grams.

During the summer of 1981, chinook brood stock was taken by angling and gillnetting in the Squamish River and its tributaries. Some 114,000 eggs were collected. Because of manpower constraints and construction delays at the Tenderfoot site, all chinook eggs were taken to Capilano hatchery for incubation and initial rearing. The resulting fry will be coded-wire tagged and transported back to Tenderfoot hatchery for imprinting and release in the spring of 1982.

Tenders for construction of the hatchery using the conventional method (i.e. awarding a contract for the whole facility to one firm) were too high. Therefore, SEP Engineering staff were used as construction manager and site superintendent, and a series of smaller contracts was awarded. Construction was coordinated on-site by Engineering personnel, and the project will be completed well within the original budget.

The project was commissioned in early 1982 for full operational capacity later in the year.

Contact: Bill Foye, Stock Enhancement Officer, Gordon Bérézay, Technical Support Biologist, Bruce Shepherd, A/New Projects Coordinator, Enhancement Operations; Ian Ross, Project Engineer, Engineering.

Sechelt Community Development Project

This project, operated by the Sechelt Indian Band, is located on the Sechelt Inlet, about 56 km northwest of Vancouver. The pilot incubation sites and sea pen facility are located in Porpoise Bay, adjacent to the village of Sechelt. The objective of the project is to enhance the local coho and chinook sport fishery.

In 1981, the project employed two Band members full-time and one assistant part-time. In October, all three were full-time staff.

In 1981, staff collected 10,000 coho eggs from returning adults released from the sea pen facility the previous summer. (These fish originated as Capilano hatchery fry and were transported to the Sechelt sea pens in February, 1980.) The eggs were incubated at two pilot hatchery sites, located at Gray Creek and Walters Brook.

Operations continued in 1981 at the sea pen rearing facility. In June, 1981, 11,500 chinook (with an average weight of 140 grams each) and 19,000 coho (with an average weight of 40 grams each) were released.

Flows, oxygen, turbidity, adult migration and spawning locations were monitored at Walters Brook, Wilson Creek and Gray Creek.

During the year, approximately 20,900 Capilano coho fry (1979 brood) and 21,187 Capilano chinook smolts (1980 brood) were coded-wire tagged. A total of 245 coded-wire tags was recovered by the Head Recovery Program from coho smolts released in 1980 at the Sechelt sea pens. Most of the fish--203 coho--had been caught in the sport fishery; the remainder were taken by the commercial gillnet and troll fisheries. Although additional tags have been recovered from adults returning to the sea pens, results have not yet been compiled.

In 1982, the project will again rear 20,000 coho and 20,000 chinook at the sea pen facility. Construction of a small hatchery near Walters Brook is being proposed.

Other work proposed for 1982 include rehabilitating local Sechelt Inlet creeks, constructing two adult collection fences and live boxes, modifying the intake system at Walters Brook, and constructing a 1,100-litre fish transfer tank.

Contact: Maurice Boisvert, Project
Coordinator, Special
Projects, Community
Development Unit.

Sliammon Hatchery

The Sliammon Indian Band operates a Japanese-style hatchery on the Sliammon River, approximately eight kilometres north of Powell River. The project's objectives are to enhance existing stocks of chum and coho in the Sliammon River and to train Band members in fish culture and fisheries management. The hatchery crew consists of five full-time employees who have been with the project since 1977.

In 1981, the hatchery crew released approximately 950,000 fed chum fry; reared 8,600 coho smolts (1979 brood) in Sliammon Lake until release; constructed a newly-designed "floating" fish fence in the Sliammon River to collect brood stock and to replace the fence that was destroyed in 1980 floods; constructed a concrete adult holding and rearing pond to replace the old plywood structure; collected 1.2 million chum eggs and 3,800 coho eggs (1981 brood); and trapped chum and coho migrating downstream in the spring to determine migration timing.

The Band's stream rehabilitation work in 1980 paid off in 1981, when coho were observed spawning in streams feeding Sliammon Lake.

In 1982, the Band will continue to modify the fish trap at the fence, place security fencing around the coho pools and rearing pond, construct an in-river standby intake to feed the new holding pond, trap chum and coho migrating downstream, collect 1.5 million chum eggs and 100,000 coho eggs, recover coded-wire tags from 1978 brood chum and 1979 coho that are expected to return to the river, monitor Sliammon River and hatchery water conditions, and operate a remote incubator on Kokanee Creek (a tributary of Sliammon Lake).

Contact: Maurice Boisvert, Project
Coordinator, Special
Projects, Community
Development Unit.

Sea-run Cutthroat, Lower Mainland and Sechelt Peninsula

A prospectus outlining sea-run cutthroat enhancement opportunities was completed in 1981 for 40 watersheds in the Lower Mainland west of Hope and in the Sechelt Peninsula north to Powell River. Intensive biophysical inventory, combined with data regarding land, water and angler use, indicated that 60 percent of the regional production target of 35,500 cutthroat trout could be attained by natural enhancement.

The results of the study, which commenced in 1979, have been summarized in the following separate formats:

Summary	
Habitat and Fish Resources	- Vol. 1
Land and Water Use	- Vol. 2
Fish Resource Users	- Vol. 3
Enhancement Options	- Vol. 4
Resource Atlas	

Copies of these reports (550 pages in total), are available only from the Surrey office of the Ministry of Environment.

The enhancement options volume was revamped in 1981 in order to provide Regional fisheries management staff with individual stream reach enhancement priorities. Included in the techniques were obstruction removal, fry stocking, low-flow augmentation (i.e. water storage) and habitat complexing.

As a result of preliminary recommendations for 1981 work, and instream work commenced in 1980, several streams (Scott, Bear, Hyde, Cedar Ditch, Murray) received habitat complexing through boulder placement, and standing stocks of salmonids were evaluated.

In addition to recommendations for sea-run cutthroat enhancement which were generated from habitat, fish populations, fisheries and supporting land and water use data, there is a considerable amount of stored information (computer tapes) for other salmonid species. It was beyond the scope of this investigation to put into perspective interactive species potential and management, but the opportunity exists with the data base.

In 1982, programs for enhancement of cutthroat will be continued. In addition, new projects will be initiated.

Contact: Dionys de Leeuw, Fisheries
Biologist, Fish Habitat
Improvement Section, Fish and
Wildlife Branch, Victoria.

Public Participation Project

Contact: Bob Hurst, SEP Community
Advisor, Nanaimo.

Powell River Rod and Gun Club

Four Club members had planned to rebuild an existing wooden dam in the upper watershed of Myrtle Creek to provide water for an incubator and rearing area for coho fry.

Vancouver Bay Project

The Vancouver Bay project, situated 90 km north of Vancouver on Jervis Inlet, is a joint DFO/B.C. Forest Products hatchery facility. The hatchery on Jitko Creek, a tributary of the Vancouver River, is designed to enhance depleted chum and pink salmon stocks in the area.

The DFO dyke and hatchery building were reconstructed early in 1981 in preparation for the fall egg-take of 1.6 million pink salmon eggs and 390,000 chum eggs. Donor stocks were obtained from Skwawka (pink) and Saltery Bay (chum). The pink fry and the majority of the chum fry will be released on emergence.

About 100,000 of the chum fry were reared in fresh water to one-gram size before release.

Contact: Kim West, Biologist, Special Projects.

Hemming Lake

Stream clearance work was done in 1981 at the outlet of Hemming Lake. Due to the formation of a new outlet created by rising lake levels during logjam build-up, the coho adult and fry access into the area has not been significantly improved.

The newly-created channel offers fish better access to the lake, provided that a high water level in the lake is maintained. Access conditions become progressively worse as lake levels drop. Complete removal of the logjam at the original outlet is proposed. However, access through this outlet will still be poor, if not impassable, due to the presence of a three-metre vertical fall directly below the outlet. Therefore, a rock crib dam will be installed at the logjammed outlet in 1982 in order to maintain a lake level optimal for feeding of the new channel. The semi-dammed channel would essentially act as an overflow channel during freshet periods.

Contact: Mel Sheng, Biological Technician, Special Projects.

Read Creek Fishway

Read Creek is about five kilometres east of Jackson Bay on the mainland. The fishway was built primarily to enable pink salmon to pass two difficult sections of the creek during low flow conditions.

In 1981, a trench was blasted at the lower obstruction to receive two aluminum steep pass fishway sections. A concrete bulkhead was poured at the upstream end to divert as much flow as possible down the fishway. The downstream end was placed so that it discharged into a small holding pool.

During 1982-83, a second short fishway will be installed approximately 20 metres upstream of the existing one to ensure passage for pink salmon.

Contact: Tom Stewart, Senior Technician, Engineering Division.

Glendale River Project

The Glendale River project is located near Glendale Cove, Knight Inlet, approximately 35 km north of Sayward.

The project, to become operational in 1983, will encompass a spawning channel for pink salmon production and a small hatchery for enhancement of other species in the Glendale system and elsewhere in the Knight Inlet. Although the Glendale system already has a fairly sizeable even-year pink run, the spawning channel will quadruple adult production to more than one million (catch plus escapement).

In 1981, consultants carried out physiochemical and spawner surveys on the Glendale, Franklin, Annuhati, Kwalate, and Mussel (Klinaklini) systems. Tom Browne Lake was scrutinized as a source for the facility's total water supply. These studies will be useful in several design areas; in particular, the existence of bacterial kidney disease (BKD), at an intensity severe enough to cause mortality, has shown up in disease analyses of resident salmonids in Tom Browne Lake. The feasibility study using this lake as a hatchery water supply is continuing.

In 1981, major contracts were let for road and bridge works into the site, providing access both for logging operations (currently underway) and Fisheries construction; and for the acquisition of rock for lining the banks of the spawning channel and for armoring the protective dike around the site.

Due to reassignment of funds to other areas of SEP, the remainder of the construction work on the Glendale project was postponed in spring of 1982.

Contact: Bruce Shepherd, A/New Projects Coordinator, Enhancement Operations; Roy McGechaen, Senior Project Engineer, Engineering.

Kakweikan River Survey

In 1981, Aquatic Resources Ltd. carried out physiochemical and spawner surveys on this system, as well as fishway counts and sampling. The project was undertaken in conjunction with the Knight Inlet studies in order to provide background biobaseline data for planning purposes. The information will be used to plan Phase II enhancement options in the Thompson Sound area. A highlight of the 1981 season was the large return of pink salmon. More than 500,000 adults were counted through the fishway in 1981; previously, total river counts were estimated at 150,000 in 1979 and 300,000 in 1980. These increases can probably be attributed to the fishway installed in 1979.

Contact: Bruce Shepherd, New Projects Coordinator, Enhancement Operations.

McNab Creek Reconnaissance

During October-November 1981, the Small Projects Unit conducted reconnaissance of possible enhancement sites in response to the interest of Canadian Forest Products Ltd. in involvement with salmonid enhancement. All streams examined flow througn the company's owned or leased land. The purpose of the reconnaissance was to locate areas used by spawning and rearing salmon, to determine availability of brood stock, and to assess and priorize the enhancement potential of each stream. Streams surveyed included: Dakota Creek, McMair Creek, Sechelt Creek, Rainy River, McNab Creek and Chilqua Creek. Enhancement work is planned on these latter two creeks, with Small Projects providing operating costs and Canadian Forest Products providing some manpower and equipment. It is hoped that this cooperation will increase both coho and chum stocks in these areas.

Contact: Matthew Foy, Biologist, Special Projects.

Lower Mainland Small Stream Boulder Placement

This Lower Mainland assessment and enhancement project involved Hyde Creek/Cedar Drive ditch, tributaries to De Boville Slough (Port Coquitlam); Murray Creek, tributary to Nikomekl River (Langley); and Bear Creek, tributary to Serpentine River (Surrey).

During the summer of 1980, boulders were placed in sections of these systems to improve rearing potential, and hence production, of anadromous salmonids, notably steelhead and/or sea-run cutthroat trout. The Lower Mainland streams were treated primarily in conjunction with the Lower Mainland cutthroat enhancement program. Springer Creek, on Vancouver Island, was selected for habitat improvement work as one of numerous enhancement projects to restore fish production to the Salmon River watershed.

In August 1981, a post-treatment physical and biological (fish sampling) evaluation was conducted at all 1980 boulder placement project sites.

Results of the evaluations were used to prescribe (and improve) these boulder placement activities in summer 1981:

- 93 tonnes of boulders were added to a 550 m project section within Scott Creek, tributary to the Coquitlam River
- an additional 44 tonnes of boulders were added to 600 m of the 1980 project section of Bear Creek
- an additional 15 tonnes of boulders were added to 150 m of the 1980 project section of Springer Creek.

Probation offices in Coquitlam and Surrey provided labor assistance for the Scott Creek and Bear Creek enhancement activities through the probationers' Community Service Program.

Results obtained from the post-treatment evaluation of 1980 project sites included:

- all 1980 project sites (with the exception of Hyde Creek) revealed higher trout densities at treated sites compared to internal controls; however, densities in treated areas (and suggested augmentations) were universally disappointing, especially when compared to similar densities in complex naturally-occurring boulder habitat in respective systems
- low fish densities were best explained by the lack of durability in 1980 boulder placements, caused by insufficient rock size (all 1980 projects); lack of clustering (Lower Mainland projects); and excessive spacing between clustered rocks (all projects, to varying degrees).

In addition, poor site selection was suggested for the poor results seen in Hyde Creek (lack of riffle habitat) and Murray Creek (low flows).

Boulder placements conducted in 1981 concentrated on:

- acquisition/placement of larger rock (greater than 0.6 m)
- tighter, more complex clustering
- creation of small rock/large rock complexes, by first laying down a "pad" of smaller rock (less than 0.6m) and then superimposing the larger boulders (greater than 0.6 m) to form the cluster.

Retreatment (augmentation with larger rock) of the 1980 Bear Creek and Springer Creek project sites was undertaken, following particularly encouraging post-1980 treatment evaluations in these systems.

The general public showed great interest and enthusiasm in the work.

In 1982, the 1981 boulder placement work will be evaluated physically and biologically. Depending on site-specific results, augmentation or extension of 1981 work within specific streams may be recommended. Placement durability/design must again be addressed to ensure maximum effectiveness of future placements in previously treated areas and new candidate streams.

The evaluation and assessment of this project is ongoing.

Contact: Bob Griffith, Fisheries
Biologist, Fish Habitat
Improvement Section, Fish and
Wildlife Branch, Victoria.

Table 1

South Coast SEP Facilities*: Juvenile Releases 1981

Species	Brood	Group	Total Released	% Marked	% Survival	Avg. Size(g)
Capilano Hatchery						
Chinook	1980	early & late	1,523,348	48.5	77.5	6.7
Coho	1979	Capilano	828,897	48	78	15.5+
Steelhead	1980	summer & winter	37,250	94.5	75.5	31.5+
Chum	1980	production	5,009	99	93	N/A
False Creek Sea Pens						
Chinook			12,447	N/A	N/A	N/A
Seymour Hatchery						
Coho			64,000	N/A	N/A	N/A
Steelhead			7,840	N/A	N/A	N/A
Cutthroat			1,340	N/A	N/A	N/A
Indian Arm Pilot Hatchery and Sea Pens						
Chinook			192,855	N/A	N/A	N/A
Coho			50,000	N/A	N/A	N/A
Sechelt Community Development Project						
Chinook			12,000	N/A	N/A	140
Coho			22,000	N/A	N/A	40
Sliammon Hatchery						
Chum			953,898	N/A	64	0.6
Coho	1979		8,593	N/A	N/A	N/A
Vancouver Bay Project						
Chum	1980		750[1]	N/A	N/A	N/A

*includes facilities constructed prior to SEP.

[1] Severe flooding caused high mortalities.

Table 2

South Coast SEP Facilities*: Status at December 1981

Species	Stock	Brood	Stage	No. on Hand	Expected Release		
					Date	Number	Site
Capilano Hatchery							
Chinook	Tenderfoot	81	alevin	104,000	May 1982	96,000	Tenderfoot Cr.
Chinook	Capilano	80	fingerling	52,000	May 1982	50,000	Capilano
Chinook	Capilano	81	egg/ alevin	1,162,000	June 1982	930,000	Capilano
Coho	Capilano	80	fingerling	525,000	June 1982	500,000	Capilano
Coho	Capilano	81	egg	1,750,000	May 1982	300,000	U. Capilano
					June 1983	500,000	Capilano
Steelhead	Capilano	81	fingerling	1,500	May 1983	1,300	Capilano
False Creek Sea Pens							
Chinook	Capilano	80	yearling	15,300	June 1982	9,300	False Cr.
Seymour Hatchery							
Coho	Seymour R.	80	fry	64,000	May 1982	64,000	Seymour R.
Coho	Seymour R.	81	egg	45,000	May 1982	40,000	Seymour R.
Steelhead	Seymour R.	80	yearling	7,840	April 1982	7,840	Seymour R.
Steelhead	Seymour R.	81	fry	14,900	Aug. 1982	14,900	Seymour R.
Cutthroat		80	smolt	1,340	April 1982	1,340	Seymour R.
Cutthroat		81	fry	360	Feb. 1982	360	Seymour R.
Indian Arm Pilot Hatchery and Sea Pens							
Discontinued							
Sechelt Community Development Project							
Chinook	Capilano R.	80	yearling	13,000	June 1982	9,734	Sechelt In.
Coho	Sechelt	81	egg	11,500	June 1983	10,000	Sechelt In.
Coho	Capilano R.	80	fry	20,000	June 1982	10,440	Sechelt In.
Sliammon Hatchery							
Chum	Sliammon R.	81	egg	1,213,300	May 1982	990,000	Sliammon R.
Coho	Sliammon R.	81	fry	5,985	--	0[1]	Sliammon R.

Table 2 (continued)

South Coast SEP Facilities*: Status at December 1981

Vancouver Bay Project					
Chum	Jitko Cr.	81		June 1982	331,500[2]
Pink		81	1,200,000		

*includes facilities constructed prior to SEP.

[1] Water problems caused a fish kill.
[2] About 100,000 of these will be reared to one-gram size.

Table 3

South Coast SEP Facilities*: Adult Production

	Expected Production from 1981 Releases		At Full Production		
Facilities/Species	Total Adult Production	Years of Return	Total Adult Production	Year	Contribution to Fisheries
Capilano Hatchery					
Chinook	39,630	1983-1987	36,000	1987	26,337
Coho	110,634	1983-1985	75,000	1984	27,075
Steelhead	766	1985-1987	600	1984	300
Chum	100	1984-1985	--	--	--
False Creek Sea Pens					
Chinook	2,384	1983-1987	324	1987	531
Coho	--	--	507	1982	5,932
Chum	--	--	72	--	313
Cutthroat	--	--	280	--	0
Steelhead	--	--	105	--	871
Pink	--	--	5,000	--	48
Seymour Hatchery					
Coho	9,600	1983-1985	10,140	--	5,932
Steelhead	314	1985-1987	1,452	--	871
Cutthroat	335	1982-1986	560	--	--
Indian Arm Pilot Hatchery and Sea Pens					
Chinook	1,157	1983-1987	5,400	1983	40
Coho	7,500	1983-1985	11,300	1984	4,043
Sechelt Community Development Project					
Chinook	3,960	1983-1987	1,080	1986	790
Coho	3,300	1983-1985	5,065	1985	1,828
Chum	--	--	3,600	1987	1,584
Sliammon Hatchery					
Chum	19,078	1984-1985	8,448	1985	19,200
Coho	1,289	1983-1985	4,242	1986	11,750

*includes facilities constructed prior to SEP.

Table 3 (continued)

South Coast SEP Facilities*: Adult Production

Facilities/Species	Expected Production from 1981 Releases: Total Adult Production	Expected Production from 1981 Releases: Years of Return	At Full Production: Total Adult Production	At Full Production: Year	At Full Production: Contribution to Fisheries
Vancouver Bay Project					
Chum	15	1984-1985	4,000	1986	1,760
Pink		--	15,000	1982	11,100

*includes facilities constructed prior to SEP.

Fraser River

Public Participation Projects

Contact: Bryan Allen, SEP Community Advisor, New Westminster.

Centennial School

Under supervision of teacher Ruth Foster, ten Centennial students worked to restore chum salmon stocks to historic levels in Mossom Creek in Port Moody. In the third year of this project, hands-on experience included installation and maintenance of the stream intake, storage system and incubation box, plus monitoring the incubation of 50,000 chum eggs of Weaver Creek origin.

Most of the alevins suffocated when the waterline froze. Approximately 500 fry were produced, and 60 of these were reared for several weeks. All fry were released into Mossom Creek.

In 1982, the students plan to develop a new incubation box and a better system of insulating the intake lines.

Sapperton Rod and Gun Club

In recent years, salmon stocks in the Brunette River have been badly depleted. However, with the efforts of the Sapperton Rod and Gun Club, there now are coho in the river.

The highlight of the year was the awarding of the Roderick Haig-Brown Memorial Trophy (B.C. Wildlife Federation) to the club in recognition of its conservation efforts on the Brunette River.

The Club had volunteered to assist the Fish and Wildlife Branch in a boulder placement program. However, plans by the Greater Vancouver Regional District to channelize and ditch the middle section of the river made it mandatory that this plan be delayed for the immediate future.

The Club also took 30,000 coho eggs from brood stock in Salmon River in the fall. The eggs were incubated and the resulting fry were reared at the hatchery operated by the Alouette River Correctional Center. Fry will be released into the Brunette in the spring of 1982.

A Warner fish-lift was built to assist fish over the Cariboo dam.

BCIT Hoy Creek Study

Two BCIT students and a member of the Port Coquitlam Rod and Gun Club have completed a study of Hoy Creek, a tributary of the Coquitlam River. They sampled juvenile and spawning fish, measured stream habitat characteristics in the mainstem and tributaries, and surveyed and mapped tributaries. A comprehensive report on distribution and rearing habitat of juvenile salmonids overwintering in the creek will be produced.

They located the rearing areas of salmonids, identified spawning periods for coho salmon, cutthroat and steelhead trout, identified habitat important to juvenile salmonids, and pinpointed areas where habitat could be improved.

Loon Lake Environmental School

This school, located in the UBC Research Forest in Maple Ridge, initiated a hands-on project for school groups in Maple Ridge. A total of 1,000 students monitored Blaney Creek and Loon Lake to obtain information on the feasibility of installing incubation boxes.

During 1981, two incubation boxes were constructed and installed in the fall. In 1982, this project will be expanded; more incubation boxes will be built and installed, and Blaney and Loon Lakes will be monitored. In addition, new courses on salmonid enhancement will be developed.

Eric Langton School
One of the grade six classes at this Maple Ridge school spent the fall monitoring, cleaning and installing an instream box in McKinney Creek. They also undertook a community education program to teach the public about the value of this small tributary of the south Alouette River.

Maple Ridge Venturers
The Venturers researched and assembled a first-class display, focussing on the status of the resource and on local enhancement activities. The display included an aquarium stocked with salmonids.

The display was exhibited at the Maple Ridge Mountain Festival Home Show, where it won awards for the best community display and the top display in the festival.

John Bentley
During 1981, John Bentley rechanneled the bottom end of Pye Creek, near Mission. This increased the spawning and rearing area available for use by coho.

Sun Valley Trout Farms
Hans Lehmann of the Sun Valley Trout Farms installed shotrock along the banks of Silverdale Creek to prevent erosion. He also removed flood debris from the creek. Mr. Lehmann installed one 50,000-egg incubator. By the end of the year, 16,000 chum eggs were incubating. Resultant fry will be released into the creek in 1982.

Coquitlam River Enhancement

The Coquitlam River flows in a southerly direction into the lower Fraser River, near the town of Port Coquitlam.

Due to a number of factors, such as habitat degradation and overharvesting of game fish in the Coquitlam River, Regional fisheries staff are focussing their efforts on fish culture, management and natural instream enhancement techniques to revitalize this once-productive salmon stream.

Although the present study centers primarily on natural enhancement methods, the results will provide direction as to which general and specific techniques are likely to have the greatest benefits for the stream, the fish, and ultimately, the angler.

In 1981, field investigations relating to stream morphology, substrates, juvenile salmonid rearing habitat and adult spawning habitat as well as the existing fish populations (all species, including salmonids) were carried out. These investigations were also conducted in 1979 for another study.

Comparison of inventory data indicate highest overall densities of juvenile trout (anadromous cutthroat and steelhead) and coho were found in Hoy Creek, rather than the mainstem Coquitlam River. In Hoy Creek, coho fry densities averaged $0.49/m^2$ (ranged from 0.17 to $0.94/m^2$), whereas in the Coquitlam mainstem, only minimal (average $0.08/m^2$, range from 0.02 to $0.33/m^2$) juvenile populations of this species were encountered. Similarly, numbers of rainbow fry were also greatest in Hoy Creek, with the average density being $0.97/m^2$ (range from 0.79 to $1.17/m^2$). In the Coquitlam River mainstem, the juvenile densities of this species averaged $0.24/m^2$ (range from 0.04 to $0.57/m^2$). The collected data and recommendations will be evaluated and incorporated in the management strategies of game fish in the Coquitlam River system.

No additional field inventory assessment work is planned for 1982. The results of this study are likely to precipitate on-site evaluation of possible instream enhancement techniques during 1982. Close liaison with other governmental agencies, should such techniques (e.g. boulder placement) be implemented, is anticipated.

Contact: Dionys de Leeuw, Fisheries Biologist, Fish Habitat Improvement Section, Fish and Wildlife Branch, Victoria.

Blaney Creek Chum Facility

The chum facility on Blaney Creek in UBC's Research Forest was not used in 1981. Adults were captured by using a fence trap on the creek and then they were transported to the Inch Creek hatchery for maturation and egg takes.

A total of 2.1 million eggs were collected and incubated in Atkins boxes at Inch Creek. Eyed eggs were transferred to keeper channels for hatching. Fry will be reared to a size of 1.5 grams, coded-wire tagged and returned to Blaney Creek in April, 1982. The fish may be held in Blaney Creek for a few days for imprinting and to allow the fry to recover from the transporting process.

A total of 26,000 adults are expected to return from the 1981 brood year.

Project evaluation is not possible for 1981, as all of the returning adults were unmarked four-year-olds from the 1977 brood year.

Contact: Bill Foye, Stock Enhancement Officer, Enhancement Operations; Dave Harding, Technical Support Biologist, Enhancement Operations.

Inch Creek Hatchery

The Inch Creek hatchery, located 15 km east of Mission, was the scene of construction during most of 1981. This new facility has a capacity of four million chum, 250,000 coho and 30,000 cutthroat trout eggs.

Of the 3.8 million chum eggs taken, 2.1 million eggs came from Blaney Creek, and the remainder came from Inch Creek. Chum eggs are incubated in modified Atkins boxes and then transferred to keeper channels prior to hatching. The chum will be reared in concrete rearing channels. After rearing and coded-wire tagging, the Blaney Creek stock will be returned to the parent stream for release.

Coho brood stock was collected from a number of small streams feeding into the Nicomen Slough area. A total of 146,000 eggs were taken.

Each coho stock, incubated in Heath trays and reared in Capilano-style troughs, will be kept separate and returned to its parent stream as fed fry.

Technicians collect data (length, scale samples) from chum salmon.

The provincial Fish and Wildlife Branch supplied approximately 30,000 cutthroat trout fry, which will be reared at Inch Creek and then released as smolts at various sites in the lower Fraser Valley during the spring of 1982.

Construction of Stage I of the production facility was started in February and completed in September. The Stage I production facility includes:

- aeration tower and groundwater supply system from two production wells
- hatchery building with an incubation capacity of four million chum eggs (modified Atkins boxes) and 250,000 coho eggs (Heath trays), mechanical/electrical room; freezer/cooler room for storage of fish food
- two areas for intermediate rearing of coho (20 Capilano-style troughs)
- four concrete Japanese-style keeper channels, to hold a total of 3.8 million chum eggs
- two concrete rearing channels (can be subdivided into four channels) for rearing three to six million chum fry
- water supply and drainage system for rearing cutthroat and steelhead trout
- an open excavated drainage/release channel to Inch Creek.

Plans for expanding the Inch Creek hatchery now are underway. This will include: six concrete raceways for extended rearing of coho, a fish sorting facility and an egg-take area. A workshop, warehouse, office and laboratory are also in the works.

Contract: Bill Foye, Stock Enhancement Officer, Dave Harding, Technical Support Biologist, Enhancement Operations; Alain Ho, Project Engineer, Engineering.

Public Participation Projects

Contact: Joe Kambeitz, SEP Community Advisor, New Westminster.

George Derksen

George Derksen, a biologist, established and monitored a 25,000-egg incubation box in his backyard. In the fall, the box incubated approximately 5,000 coho eggs taken from the Nicomekl system. By the end of the year, there were approximately 4,500 alevins, some just buttoning up. In 1982, Mr. Derksen plans to release all but 1,000 fry--which he will rear for one year--in the Nicomekl system.

B.C. Wildlife Federation

At the beginning of the year, four students (under the auspices of the B.C. Wildlife Federation) spent two months clearing debris from the creek bed of Anderson Creek, which flows into the Nicomekl River. The group spent a further two months clearing a jam on the Salmon River and assisting the Coast Steelheaders with its downstream smolt trap. (See the Coast Steelheaders' project.) This project was funded by a Canada Manpower grant.

Coast Steelheaders

This project was an ambitious one, involving the Department, provincial Fish and Wildlife Branch, Howard Paish and Associates, Surrey Fish and Game Club, B.C. Wildlife Federation and the Vancouver Angling and Game Association, plus many volunteers in the area. The task was to trap all smolts migrating downstream from April to July and then transport them over the destructive flood pumps on the lower Salmon River. (The pumps would otherwise kill a large percentage of the smolts.) The task was successfully completed in the three-month period.

Area Specialists and Area Volunteer Projects

Six area specialists assist other groups or coordinate area volunteers when extra help is needed.

Under the supervision of area specialist Voldemar Kamaldnieks, volunteers worked or assisted on a variety of projects in 1981, including projects on: Downes Creek, Little Chilliwack, Anderson Creek, Murray Creek, Salmon River incubation, the Salmon River smolt trap, Hyland Creek and the Little Campbell River fence.

The area specialists assisted in most of the egg takes in the area, as well as in rock placement, jam clearance and photography.

Joe Hopink

Joe Hopink of Langley has continued with the incubation box for coho built last year on the Salmon River. Early in 1981, the project suffered as a result of the floods that occurred in late December, 1980; in addition, 7,000 of the 15,000 eggs failed to fertilize. When the intake was modified and the box was cleaned of sand deposited by the floods, 1,000 fry were produced.

Over the summer months, the entire project was rebuilt. Union Creek was diverted around the site. A concrete pad was poured, concrete blocks were laid down, and an incubation box was constructed. A shed was built over the structure to protect the fishway.

In the fall, 18,000 coho eggs were taken in five egg takes in the Salmon River. High water plagued these efforts. By the time the weather improved, many of the fish had already spawned. Hundreds of fish migrated upstream through the fishway and many of them backed out the Salmon River again.

Of the original 18,000 eggs, 14,000 of them were lost; the 4,000 remaining eyed eggs and alevins were released in a gravel stretch in Union Creek.

The project is continuing; a priority for the system is to capture some good brood stock in the fall and hold these adults for spawning.

Nate Bello

This project--installation of a 10,000-egg incubation box on Hatchery Creek on the Wannock River--started in November, 1980, and was expected to come on line in the fall of 1981, with Owikeno School participating. During the summer of 1981, it was decided to install the incubation box in the winter and test its operation without eggs during the year (before risking valuable chinook eggs in it). However, this was not done because of lack of manpower. At the end of the year, Mr. Bello decided to throw in his lot with a fellow near the mouth of Wannock River, and they will attempt to install a floating incubation box there. The incubation box was not installed in 1981.

Semiahmoo Fish and Game Club

The Club now is in its second year of a five-year project of reconnaissance and evaluation of salmonid stocks on the Little Campbell River system. The fence and trap which were constructed in the first two years were broken many times by high water. A new steel fence was constructed at Cloverdale High School, with advice from Small Projects engineers, and then installed during the summer.

During the fall, the new steel fence and concrete sill were working very well; Club members were counting steelhead, chinook, chum, coho and cutthroat stocks past the fence. Day-to-day count statistics were phoned in to Fisheries staff in New Westminster.

The trap is used to collect steelhead brood stock for the Abbotsford trout hatchery. The progeny will be planted into the Nicomekl, Serpentine and Little Campbell Rivers.

Plans for the next two years of this project include: bringing in power to the site; developing a well and water system for incubation, holding and rearing; constructing an adult holding

The Semiahmoo Fish and Game Club installed a new steel fence and trap on the Little Campbell River system. The previous fence had been broken many times by high water.

and incubation system; and developing a rearing capability for either trout or salmon.

About 50 people are involved in this project.

Chilliwack Fish and Game Club

Since 1980, the Club has been involved with a project to increase salmonid stocks in Little Chilliwack Creek, which is utilized by coho and chum salmon and cutthroat trout. Engineering surveys of Little Chilliwack Creek were well underway at the beginning of 1981. The Chilliwack Native Band Council provided three men for the project, and many days of work were donated by Center Creek Corrections Camp inmates, who cleared the area during the summer.

Surrey Fish and Game Club

Early in 1981, Club members cleaned and cut a small falls and jam area on Hyland Creek, a tributary of the Serpentine River. Residents along the creek reported that there were more coho on the spawning grounds than have been seen in recent years.

The Club proposed to incubate 25,000 coho eggs from the Serpentine for planting into Hyland Creek. Various sites were examined for an incubation facility, and the group finally chose a site on the Serpentine fen property. Later in the year, 6,000 coho eggs were taken from spawners in the upper tributaries of the Serpentine. Approximately 4,000 eggs hatched in the incubation box, which used water from an artesian well. All the resultant fry will be transported to Hyland Creek.

About 10 people were involved in this project in 1981.

Skow-Kale Project

Three members of the Skow-Kale band started working on this Little Chilliwack Creek project in the spring, in preparation for the fall egg take of coho and chum salmon. Three incubation boxes constructed by students at the Chance Alternate School were installed. During the summer, 12 foreign exchange students stained the buildings and landscaped the site. Using heavy equipment, the troops from the Canadian Forces Base at Chilliwack spent 70 days excavating a deeper channel for Little Chilliwack Creek.

In the winter, 40,000 chum eggs were taken from Vedder River, with the assistance of Chilliwack hatchery staff. A cold snap at Christmas reduced the oxygen level in the incubation box, resulting in an estimated 50 percent mortality rate. In January, 1982, 30,000 coho eggs were taken from Elk Creek brood stock at the provincial Fish and Wildlife Branch's fence on Hope-Camp Slough. To date, there is a 95 percent survival rate.

Mt. Thurston Corrections Camp

This provincial corrections camp did not undertake a specific project in 1981, but it did help Center Creek Corrections Camp by cutting and supplying all building materials for its salmonid enhancement projects. On the Chilliwack system, all work proposed by the Mt. Thurston camp will be done in consultation with Chilliwack hatchery.

Center Creek Corrections Camp

This camp, a facility for juvenile offenders, has been enhancing salmon stocks in the Chilliwack River system. A small hatchery was constructed over the summer months, with two 50,000-egg incubators, pumps and standbys donated by the Inches Creek hatchery. With assistance from Chilliwack hatchery staff, 40,000 eggs were taken from chum spawners in the Vedder River. Despite power outages, pump failures and cold weather, the egg-to-fry survival rate has been 99 percent. About 20 youths were involved in the project.

K.B. Woodward School

In the fall, approximately 75 Woodward students returned to Penny Lane Creek and placed by hand five cubic metres of gravel for spawners. They also cleaned up along some 500 metres of creek.

A 2,500-egg incubator was constructed for use in the classroom. However, the incubator was plagued by apparent water quality problems, and the 2,000 coho died immediately.

Chilliwack Senior Secondary

The students constructed a classroom incubator, and approximately 1,000 of 1,500 chum eggs were successfully hatched. Students received 14 coho fry from the Chilliwack hatchery in order to gain some experience in rearing fish. All the coho were reared successfully. All of these fish will be returned to Chilliwack River or to the hatchery.

Boy Scouts of Canada

Fifty Boy Scouts cleared urban debris from Crassus and Langley Creeks in early June. Langley District staff removed all material to a landfill site.

Mr. and Mrs. Roy Long

During the summer, the Longs and a crew of eight reinforced a jump pool and created pools above it on McNally Creek, part of the Little Campbell River system. Some of the silt in the lower river was removed. During the winter, the group plans to hand-place some heavy rock along the river to stabilize the banks.

Crescent Park Elementary School

The pupils assisted with the adult coho enumeration for several days at the Semiahmoo Fish and Game Club fence during the fall. They also dissected a fish to learn about salmon anatomy.

Chance Alternate School

The school constructed three 50,000-egg incubation boxes, which were installed at the Skow-Kale project.

Alouette River Correctional Center

The Alouette River hatchery is located on the South Alouette River, 10 km northeast of Haney. This project was initiated to provide meaningful work for inmates of the Alouette River Corrections Camp and to help rehabilitate the salmonid stocks of the Alouette River system.

The Alouette River project is operated by the inmates and supervisory staff of the Alouette River Correctional Center. In the fall of 1981, the Small Projects Unit took over the administrative and biological support of this project from the Community Development Program.

The production well drilled in 1980 ran into water quality problems and was shut down in the spring of 1981. A new well site has been found, and drilling will commence in the spring of 1982.

During the fall of 1981, groundwater sites located near the camp were found suitable for incubation and rearing.

Approximately 75,000 Alouette River chum, 34,000 Salmon River coho, and 5,600 Alouette River steelhead were reared for release in the spring of 1982. The Salmon River coho will be released into the Brunette River as part of an ongoing coho recolonization program with public involvement. Both the chum and the steelhead will be released into the Alouette system. All fish held on-site will be coded-wire tagged prior to release.

Contact: Kim West, Biologist, Special Projects.

Salmon River Flood Assessment

The Salmon River is a tributary of the Fraser River, near the community of Langley, and drains primarily low-lying agricultural land.

Fisheries investigations in the Salmon River during the summers of 1979, 1980 and 1981 were directed at assessing the impacts of two floods (December 1979 and 1980) on stream morphology, substrates, juvenile salmonid rearing habitat and fish populations (primarily salmonids).

In 1981, fish populations and associated stream habitat were examined, and data were compared to the 1980 and 1979 assessments.

Preliminary results indicate that the December 1981 flood had no major impacts on either the fish populations or their habitats. These results corroborate the previous findings on this stream, where only minor flood impacts (flood of December, 1979) were noted.

The collected data will be useful to help determine management strategies of relatively low-gradient, flood-impacted streams.

No additional field work is planned for 1982. Further statistical analysis of the previously-collected inventory information is required in order to complete the report, which should be available in April 1982.

Contact: A. Dionys de Leeuw, Fisheries Biologist, Fish Habitat Improvement Section, Fish and Wildlife Branch, Victoria.

Stave River Reconnaissance

The monitoring of reservoir water temperatures continued through 1981, and a brief reconnaissance of some potential alternate water supplies in the area was undertaken. Due to various constraints, this project will be postponed until Phase II; however, the Inch Creek hatchery will be handling Stave River stocks in the interim.

Contact: Bruce Shepherd, New Projects Coordinator, Enhancement Operations; George Neilsen, Senior Project Engineer, Engineering.

Fraser Valley Trout Hatchery & Offsite Rearing

The Fraser Valley trout hatchery in Abbotsford is a provincially-operated facility, which mainly produces rainbow, steelhead and cutthroat trout. Eggs from several steelhead and cutthroat stocks are incubated, and the fish are reared at this hatchery in temperature-controlled water for varying periods of time. Cutthroat reared at the hatchery are transported to off-site rearing ponds at Surrey, Inch Creek, and Vancouver Island, where they are fed for an additional six or seven months until reaching smolt size. Elevated temperatures (above the 9.4°C ambient well water supply) are used to culture steelhead fry up to five grams in size for colonizing streams.

Tour guides and extensive public displays at the Fraser Valley trout hatchery, along with education programs, assist the general public and schoolchildren in interpreting and understanding SEP.

Adult cutthroat and steelhead brood stocks for fry and smolt projects are collected in various ways. Electrofishing gear was used to capture the small numbers of anadromous cutthroat which move into streams over the winter months of freshet. Angling is the preferred method of obtaining steelhead from large streams, such as the Coquihalla River, whereas a combination of seining and angling is used to collect brood stock from the Alouette River. The Semiahmoo Fish and Game Club provided assistance in securing steelhead adults from the Little Campbell River. The construction of a fence and trap, by the Semiahmoo club, provides a means of evaluating juvenile survival of all anadromous salmonids in this stream.

About 40 percent of the '82 summer steelhead taken from Coquihalla River for brood stock were of hatchery origin. Fry in excess of what are needed for a release of 10,000 wild fry in 1982 and 30,000 wild smolts in 1983 in the Coquihalla will be used to colonize the Silverhope. Eggs collected from 29 wild adults of Silverhope Creek origin will provide additional fry for release into the Silverhope in 1982. This will be the fourth year that Silverhope Creek has been colonized and the fry releases evaluated.

Juvenile steelhead (fry) of one to two grams in weight were also introduced into the Ashlu River (Squamish), Shovelnose Creek (Squamish), Little Campbell River, Murray Creek and the Alouette River system. Evaluation has shown that fry introduced into vacant habitat in several streams on Vancouver Island and the Lower Mainland survived well to one and two years of age.

In late August, 5,500 steelhead of Alouette River origin were transferred from Fraser Valley trout hatchery to the Alouette River Correctional Center. These six- to seven-gram fish will be reared to migrant size by inmates and supervisory staff. The fish will be released in the Alouette River in 1982.

Anadromous cutthroat destined for rearing ponds in Surrey, Inch Creek and

Abbotsford hatchery staff make preparations to airlift trout fry to under-utilized areas of rivers in the Lower Mainland.

Vancouver Island were also reared in elevated water temperatures at this hatchery. Steelhead destined for release into the Little Campbell River are also reared at Fraser Valley trout hatchery before being transferred to ponds at Surrey for supplemental rearing. Good growth and survival have been experienced at the two off-site rearing ponds, and large numbers of adults are expected to return in future years.

Holding late-run (March) Squamish adult steelhead continues to be a problem, with high mortalities due to fungus occurring. Various holding procedures, plus the use of antibiotics, are being evaluated in order to reduce mortality of this stock.

Approximately 77,650 of the total eggs collected from Zymoetz River (North Coast) steelhead were shipped to Abbotsford for incubation and rearing. During September 1981, 51,500 (66 percent) marked fry (4.3 g) were taken by truck from Fraser Valley trout hatchery and dispersed in the headwaters of the Zymoetz River.

Contact: Don Peterson, Hatchery
Supervisor, Fraser Valley
Trout Hatchery, Abbotsford.

Hatchery Return Assessment & Brood Capture

In 1981, this Lower Mainland project primarily covered those streams that have been stocked with steelhead and sea-run cutthroat trout and where adult returns were expected during 1981. These systems included: the Coquihalla River, for summer steelhead; the Nicomekl, Vedder and Alouette Rivers, for winter steelhead; and the Serpentine (including Crescent Beach marine area), Brunette, Stave and Fraser Rivers and the Nicomen and Hope-Camp Sloughs, for sea-run cutthroat.

The project's overall objective is to determine the success of the hatchery methods and program by studying adult returns of steelhead and cutthroat from hatchery stocking. More specifically, the project attempts to determine:

- the actual hatchery return, compared to the projected returns
- the contribution of hatchery fish to the sport fishery, as well as where and when both hatchery and wild fish are being fished for and caught
- successful methods for encouraging anglers to provide data voluntarily on hatchery and wild fish, outside of the creel census.

Two Regional SEP technicians gathered information on returns of hatchery adults by conducting interviews with anglers on-stream, by studying angler log books, and by counting fish in indicator streams and areas. For various reasons, adult steelhead and cutthroat are very difficult to enumerate in coastal streams. Therefore, hatchery return assessments tend to produce more subjective results, as opposed to a detailed statistical summary.

The largest hatchery return of summer steelhead to date was expected to return to the Coquihalla River during the summer of 1981. Snorkel surveys and an angler creel census indicated a combined 1981 return of hatchery and wild steelhead which was less than the 1980 return. During August and September, anglers were estimated to have fished 900 days to catch 109 steelhead. (This was half the 1980 catch for the same amount of angler effort.) During 1981, hatchery steelhead comprised about 50 percent of the total steelhead caught; this proportion was similar to 1980. Results from swim surveys, to count steelhead, were the same as in 1980.

Vedder River

An angler log book program was started to obtain information on winter steelhead stocks on the Vedder River. Successful anglers who are reliable and spend much time on the river were given booklets to record their season's results and observations; this appears to be a very worthwhile method to use to obtain a seasonal overview and a large sample of steelhead. It should be valuable when comparing successive seasons. Using log books, 17 anglers reported a total of 341 days fished on the Vedder for a catch of 237 steelhead. About six percent of these fish were hatchery returns. Twenty-nine hatchery steelhead heads were returned to Fish and Wildlife for analysis. A swim survey, to count adult steelhead, revealed over 750 fish, the highest number counted since 1973.

North and South Alouette River (Winter Steelhead)

A creel census provided data on winter steelhead stocks on the North and South Alouette River in the 1981 season. An estimated 542 days were spent to catch 83 steelhead (12 percent of these fish were of hatchery origin). In addition to steelhead angling effort during the steelhead run, an estimated 361 days were directed specifically at fish other than steelhead (i.e., cutthroat, whitefish).

Nikomekl River

There was limited effort expended to collect data on the winter steelhead runs to the Nicomekl River. Success for steelhead was poor, but a few steelhead of hatchery origin were rumored to have been caught in early 1981.

Sea-run Cutthroat Trout

To gather data on sea-run cutthroat trout stocks, staff checked anglers on approximately nine different stream and slough locations in the Lower Mainland. This effort was concentrated on waters that had been stocked with hatchery cutthroat smolts or on areas adjacent to these waters where anglers were likely to encounter hatchery fish. Surveys were undertaken from late September to December, but effort and catch during this time was low. Insufficient data were obtained to estimate hatchery returns.

Study on hatchery returns of steelhead and sea-run cutthroat trout will continue through 1982, but the work will be expanded and refined. More log books will be used to record catches of both species. Angler effort and catch of cutthroat will be sampled for a longer period.

Brood Capture

Wild steelhead and cutthroat spawners from the Squamish and Alouette Rivers supply the brood stock to provincial and federal hatcheries to meet hatchery fry, smolt, or adult production goals for several river systems.

With assistance from volunteers from the Coast Steelheaders fishing club, staff captured brood stock in the upper Squamish River in 1981. These fish were transported, by truck, to Fraser Valley trout hatchery, where they were spawned. The eggs were hatched and the 30,000 resulting fry were placed above the falls on Ashlu Creek, a tributary to Squamish River. This is the second fry plant to upper Ashlu Creek. (The first planting was done in 1980 and fry sampling in the summer of 1981 indicates that the fish are surviving and growth is very good.)

Mortalities among brood stock during hatchery holding were lower in 1981 than they were in 1980.

The Lower Mainland SEP field crew assisted provincial fish culture staff in capturing wild brood stock on Alouette River. In addition to work on the Squamish and Alouette Rivers, the Lower Mainland SEP field crew will be responsible for supplying steelhead brood stock for the federal hatcheries on Tenderfoot Creek (Cheakamus River system) and on the Chehalis River (Chehalis/Harrison River system).

Contact: Peter Caverhill, Fisheries Biologist, Fish and Wildlife Branch, Surrey.

Vedder River Side Channel Development

The Vedder River Management Area consists of 320 ha of Crown-owned land (including the riverbed) between setback dykes below Vedder Crossing, as well as a 203-ha parcel downstream. The land, which contains many side channels and tributaries between the dykes, was examined for its potential for enhanced salmonid production. Issues investigated were:

- present salmonid utilization
- habitat quality
- factors limiting production
- enhancement opportunities.

In 1981, habitat assessment and fish sampling were conducted in three potential side channel/tributary development sites within the Vedder River Management Area. Due to the common seasonal use of side channels and tributaries by mainstem fish populations, the sites were assessed in July 1981 (summer conditions) and again in November 1981 (fall/early winter conditions).

Most fish sampling was conducted in areas currently providing complex fish habitat, so as to project what production potential (including seasonal use patterns) could be expected with full habitat development in selected areas. Cover-poor areas (in the mainstem and one side channel were sampled for comparison.

In July, the mean total biomass density sampled in suitable side channel/tributary areas was 3.99 g/m^2. Coho fry dominated the biomass at this time (mean 2.44 g/m^2), followed by steelhead/rainbow yearlings (mean 1.08 g/m^2), and steelhead/rainbow trout fry (mean 0.12 g/m^2).

In November, the mean density at such sites was 9.23 g/m^2. Coho fry remained the major component of biomass. The mean sampled density for this species was 3.56 g/m^2, a 46-percent increase over the July results. Again, steelhead/rainbow yearlings represented the second largest component of biomass (mean 3.15 g/m^2), but the increase here (compared to July) was 192 percent. Although the mean sampled biomass density of steelhead/rainbow fry (mean 2.03 g/m^2) remained lower than yearlings and coho, it had increased 16 times relative to the results in July.

Furthermore, while the mean numerical density (fish/m^2) of steelhead/rainbow yearlings and coho fry remained the same (or similar) July to November, that for steelhead/rainbow fry increased by 118 percent (0.17 fry/m^2 in July, compared to 0.37 fry/m^2 in November).

Tentative conclusions from these data are:

- the side channels are utilized for year-round production of steelhead/rainbow trout and coho salmon, and undoubtedly, as refuge areas for mainstem fish populations during winter (perhaps most notably steelhead/rainbow fry)
- the habitat quality ranges from excellent to extremely poor at various sites; all areas will require some habitat improvement work to bring them into full production
- as observed in 1981, the major factors limiting production are the availability and accessibility of suitable spawning and/or rearing habitat.

A few enhancement opportunities were identified: provision of complex rearing habitat in the Peach side channel; debris/beaver dam removal, and spawning habitat improvement in Hopedale Slough/Street Creek; and debris/beaver dam removal and spawning/rearing habitat improvement in lower Barnet Creek.

Contact: Bob Griffith, Fisheries
Biologist, Fish and Wildlife
Branch, Victoria.

Vedder Pen Rearing — Steelhead

In conjunction with the 1977 rationale of net-pen rearing steelhead to smolt size, steelhead culture has been taking place each year. In spring of 1981, three groups of fish were released into tributaries of the Vedder/Chilliwack River system.

One group was released into Foley Creek (6,638 fish, at an average size of 58.5 grams each) hatchery complex; the other two groups spent their latter rearing time in semi-natural net pens in the Chilliwack Armed Forces bridging pond. Then, 9,913 fish (averaging 60 grams each) were released into Salwein Creek, and 8,885 fish (averaging 59.7 grams each) were released into Slesse Creek. A fish trap located at Salwein Creek captures returning adult fish. Information from the fish-trap operation, along with angler catches, provides an ongoing source of data for:

- imprinting tendencies and timing
- rearing temperature fluctuations
- optimum release sizes and dates
- brood stock quality (age crosses).

In 1981, this information was obtained from a total of 72 fish (half were caught in the fish trap while the others were caught by anglers).

A high percentage of the brood stock collected from upper Chilliwack in December 1981, were of hatchery origin. These appear to be the first significant returns for the Foley and Slesse systems. In the past, most of the hatchery fish that returned had been released in Salwein Creek and appeared as late-run (March) fish. This finding held true, even though the parent fish were taken from early-run wild fish, and suggests that fish returning to higher systems of the Chilliwack River tend to return as earlier-run fish.

In 1982, two groups of 10,000 fish will be released into one system. One group is being reared in net pens; the other, in the hatchery complex. Given identical sizes, condition and release times, these two groups can be compared. The excess early-rearing space at the hatchery will be used to boost the growth of 6,500 steelhead, destined for Slesse hatchery, in mid-summer. These fry will be monitored for growth, temperature and densities, and the data will be coupled with the previous year's findings. By the end of this rearing period, data should be available to construct accurate growth graphs for optimum rearing temperatures.

Contact: Bob Land, Fisheries Research,
Fraser Valley Trout Hatchery,
Abbotsford.

Chilliwack Hatchery

The Chilliwack River hatchery is located on the Chilliwack River, approximately 32 km from its confluence with the Fraser River and 20 km from the town of Chilliwack. It will be a major producer of chum, chinook, and coho salmon, and steelhead trout.

The hatchery was designed to incorporate semi-natural (earthen channel) rearing conditions for coho and steelhead with the more conventional concrete raceways used for rearing chinook and chum salmon, as well as for holding brood stock. Chum salmon are incubated in Atkins incubators and keeper channels, while the eggs of other species are incubated in vertical Heath stacks. All incubation and rearing facilities have supplies of both river and well water. Two wells supply approximately 106 litres per second of 11°C water for use in controlling the development rates of selected species through temperature manipulation.

The hatchery building and concrete channels were completed on schedule in 1981, and the hatchery now is operational. Modifications were made to a few aspects of the design, including adapting packed columns to the aspirators in the aeration tower to reduce nitrogen levels; designing an aluminum cover for the chum keeper channels, thus eliminating the need for a conventional building, at considerable cost saving; and establishing unique automatic control valves in the river water supply, which proved to be such a resounding success last season.

The hatchery was designed and built to meet the local community's request for a natural setting and rearing environment. In addition, consideration for expansion was included in the original design and space has been provided to accommodate major production of chinook salmon, doubling chum production and tripling coho production.

The hatchery was partially complete in the fall of 1980, and chum, coho and steelhead eggs were taken to be incubated in this facility. These coho and steelhead are still being reared, while the first group of chum salmon was released in the spring of 1981. The facility was completed in the summer, and in the fall, 5,000,000 chum, 500,000 coho and 630,000 chinook eggs were taken.

Adult steelhead are being held, and an anticipated 175,000 eggs will be taken from brood stock in a cooperative effort with the provincial Fish and Wildlife Branch.

Coho and steelhead donor stock is collected off-site and transported back to the hatchery for holding. Chum eggs are taken from brood stock off-site and transported to the hatchery. Chinook eggs were taken from Pitt River (130,000), Harrison River (500,000), and Chilliwack River (4,000). Since the chinook run is very small on the Chilliwack River, transplants from other systems will be required to develop a viable stock.

An imprinting experiment will be undertaken in the spring of 1982 to determine homing patterns of coho that have been reared to smolt in the hatchery and released with varying periods of residence in their natal stream. The outcome of this experiment will help develop release strategies in the future.

Chilliwack River wild coho contribute greatly to the sport and commercial fisheries in the Gulf of Georgia and south Vancouver Island; enhancement of these stocks will have a major effect on these fisheries. Chinook production will benefit both commercial and sport fishermen and help replenish the diminished Fraser River stock, while chum production will benefit the commercial fishery. Steelhead production is aimed to re-establish the Vedder-Chilliwack River system as the premier steelhead stream of the Fraser Valley, as it was a decade ago.

Contact: Don Buxton, Manager,
Chilliwack River Hatchery;
Wayne Peterson, Senior
Project Engineer,
Engineering; Dave Harding,
Support Biologist,
Enhancement Operations.

Chehalis Band Project

The Chehalis Band project is located on the Harrison River, in the upper Fraser Valley, where Band members have been working with SEP since 1978 to enhance local salmon stocks. The project trains local residents in fish culture techniques and project management in order to maximize their chances for employment at the Chehalis River hatchery, which now is under construction.

Chum brood stock is collected; the fish will be stripped of their eggs and will be incubated in the band's incubation pits.

Band members investigate alternative rearing strategies for chinook production, assess incubation pits and improved groundwater-fed sloughs as alternative methods for chum production, and attempt to locate and rehabilitate a relic stock of Chehalis chinook.

In 1981, a crew (ranging in size from three to 14 persons) worked on various aspects of salmonid enhancement. Band members operated a pilot rearing facility at the Chehalis River site. On Smokehouse Slough, located on the reserve, the Band operated and developed another pilot incubation facility. Fry were produced in incubation pits and improved sloughs, and enumerated. Beaver dams were monitored and breached as part of a stream improvement program. Chum spawners were also enumerated in improved and control sloughs. Band members also collected brood stock, taking and incubating 100,000 Harrison River chinook eggs and 100,000 Weaver Creek coho eggs. Additional chinook brood stock was captured to supply Chilliwack hatchery with 500,000 chinook eggs.

Contact: Chris de Hrussoczy-Wirth,
Project Coordinator, Special
Projects.

Chehalis Hatchery

Progress on the design and construction of the Chehalis hatchery complex progressed generally as scheduled during 1981. This $6.8-million hatchery will enhance stocks of chinook, chum and coho salmon and cutthroat and steelhead trout from seven rivers in the Harrison-Chehalis area.

From an engineering standpoint, progress was made in several areas:

- the hatchery building was fully finished and equipped; it includes an incubation room, laboratories, offices, storage space, workshop, mechanical room and a walk-in freezer/cooler

- a concrete river bank intake was constructed
- the design for the groundwater supply, aeration tower, all water distribution piping, rearing facilities (concrete and earthen ponds, aluminum troughs) were completed and ready for tender.

Scheduled completion of the facility is August, 1982, in time for the fall egg-take.

Contact: Wai Leung, Senior Project Engineer, Engineering; Bruce Shepherd, New Projects Coordinator, Enhancement Operations

In 1981, engineering work was done on the Chehalis hatchery water intake.

Assessment of Natural Enhancement Side Channels

In 1981, an assessment was made on 12 sites which have been, or will be, naturally enhanced. These sites are primarily groundwater creeks or side-channels used by chum salmon; coho salmon also use these areas but to a lesser extent. Eight of these sites--Billy Harris Slough, Little Mountain Slough, Hopedale Slough, Worth Creek, Railroad Creek, Judd Slough, Westholme Channel and Lower Paradise Channel--have had enhancment work done on them in the past. Other sites being considered for enhancement work include: Street Creek, Chilqua Creek, Peach Creek, and Upper Paradise Slough.

This assessment included: adult enumeration and estimation of egg deposition (12 sites), hydraulic sampling (11 sites) and downstream fry enumeration (two sites). More than 38,000 adult chum used these areas for spawning in the fall of 1981, with a potential deposition of 57 million eggs.

Information gathered during this assessment will be used to direct future enhancement work and to refine enhancement techniques.

Contact: Matthew Foy, Biologist, Special Projects.

Sea-run Cutthroat, Hope Camp Slough

Stocking of sea-run cutthroat trout smolts continued on the Hope Camp systems in the spring of 1981. A total of 10,323 smolts, ranging in size from 45 to 52 grams, were released.

The Hope Slough enumeration fence was put back in operation in late September of 1981. Due to poor conditions, the fence could not be operated on a full-time basis and the majority of the run was missed. Creel data on this system are virtually non-existent, as these fish migrate during peak flows in the winter months. Water and weather conditions, combined with low returns, are a strong deterrent to anglers.

Reports from anglers indicate that there is substantial straying of marked cutthroat from the Hope Camp systems; fin-clipped fish have been caught in various sloughs and streams as far up the Fraser River as Bridal Falls. In addition, there appears to be a high residualism rate for cutthroat which allows for a popular spring fishery for residents.

Contact: Bob Land, Fisheries Research, Abbotsford Hatchery.

Jones Creek Spawning Channel

The Jones Creek spawning channel, located approximately 16 km southwest of Hope, was constructed by the B.C. Electric Company (now B.C. Hydro and Power Authority) in 1954 in order to compensate for the substantially reduced flows into Jones Creek. These flows were reduced when a hydroelectric installation resulted in the diversion of a large portion of the natural water flow from Jones Lake into penstocks, delivering approximately 6 m^3/sec to the Wahleach power generating station site. This site is located adjacent to the Fraser River, some 13 km downstream from the mouth of Jones Creek.

Subsequent to 1954, the spawning channel has been maintained by B.C. Hydro and operated by DFO. The channel was constructed primarily to mitigate the effects of the hydroelectric installation on pink salmon stocks. The average pink salmon adult escapements to the channel between 1954 and 1981 have averaged 2,000 pieces.

Under the general supervision of a Departmental representative, extensive maintenance work was undertaken in the channel by B.C. Hydro in 1981. The work, which cost approximately $70,000, included removing material from the two settling basins, replacing the spawning gravel, undertaking extensive repairs to the fish barrier fence, replacing the wooden fish counting installation with a reinforced concrete structure, and installing a screen at the water supply intake.

The channel was considered to be in excellent condition to handle the pink salmon run in 1981, and approximately 2,100 fish subsequently utilized the channel.

Studies are being undertaken to determine the potential for increasing salmon production in the Jones Creek system, if the existing facilities are converted to a more intensive fish culture system.

Contact: George Nielsen, Senior Engineer, Engineering; Bruce Shepherd, A/New Project Coordinator, Enhancement Operations.

Silverhope Creek Steelhead

In the early stages of SEP, Silverhope Creek (3.2 km southwest of Hope) was identified as a system with potential for providing an excellent summer steelhead fishery for Lower Mainland anglers. Baseline assessment in 1978 suggested that poor adult return (30 to 50 fish) was due to underseeding of the abundant prime habitat for rearing steelhead juveniles. Consequently, an experimental release of 11,400 summer steelhead fry was conducted in July 1979. Favourable results from these releases motivated a second release of 47,000 fry in July 1980. This, in turn, led to larger releases and post-release assessment in 1981.

Assessment of Silverhope Creek in August 1980 emphasized the necessity to acquire information relative to smolt/presmolt emigration from Silver Lake located approximately 8.5 km above the mouth of Silverhope Creek. From April to July 1981, seven attempts were made to monitor smolt/presmolt emigrations near the outlet of Silver Lake and in the stream itself, below the lake. A large trap net was used in the lake near the outlet. Fyke nets and a full stream-width trap net were used in the stream.

Unfortunately, stream sampling was virtually fruitless, and lake captures were inconclusive with respect to whether anadromous or lake resident juveniles had been captured. Therefore, information on smolt output (notably from hatchery releases) is still lacking.

In August 1981, 95,870 summer steelhead fry were released to a 18.5 km section of Silverhope Creek above Silver Lake. As in the 1980 releases, fry were uniformly scattered throughout the release section; technicians weighed out the requisite number of fry per section (between adjacent access points) and distributed them.

The seeding rate was 5.2 fish/linear metre of stream, or 0.7 fish/m^2. The 1981 release site represents the entire length of Silverhope Creek above Silver Lake. It also includes all 1980 and 1979 fry release areas.

Of the 95,870 fry released in early August 1981, approximately 81,202 fry are estimated to have survived. This represents an 84.7 percent survival rate for 1981, compared to 69 percent and 70 percent in 1980 and in 1979, respectively.

A post-release assessment was conducted during September 1981. Fish were sampled by electroshocking at seven sites to replicate sampling conducted in 1980 and 1979. Of interest were the cumulative effects of 1979, 1980 and 1981 releases, and comparison of sampled fish densities (g/m^2), suggested by 1978 baseline assessment.

The yearling survivors from 1980 fry releases are estimated to be 7,898 fish, representing a survival rate (from release to September 1981) of 16.8 percent. (Survival rate for July 1979 releases to late August 1980 was only 9.7 percent.) Survival rate from 1980 census (late August, as fry) to September 1981 (as yearlings) was 24.3 percent (compared to 13.8 percent for the 1979 releases between the August 1979 and August 1980 assessments).

In total, only four adult survivors (age 2+) from the 1979 fry releases were captured. Approximately 110-120 fish, or 10 percent of the survivors from the release in August 1980, are remaining in Silverhope Creek above the lake.

It is unknown what proportion of the 1979 release actually emigrated as age 2+ smolts, but the lack of 1979 hatchery fish above the lake does suggest a major emigration, despite superabundant habitat for age 2+ fish.

On the basis of four years' study (1978 to 1981, inclusive), an annual adult return of between 600 and 700 summer-run steelhead should result from full seeding of Silverhope Creek above and below Silver Lake.

Completion of the 1981 post-release assessment terminates the principal involvement of the Fish Habitat Improvement Section in the Silverhope Creek enhancement program. The diagnosis of inadequate recruitment appears to have been confirmed. However, juvenile steelhead populations about Silver Lake have been progressively built up with three years of fry releases. Initial adult returns (jacks) from 1979 releases are expected in 1982. The first significant return of hatchery fish will likely occur in 1984.

Total fish biomass densities at the seven electroshocking study sites varied from 2.73 g/m^2 to 17.58 g/m^2. The mean sampled density was 8.50 g/m^2. Only one site revealed less than 5.0 g/m^2, and four were in excess of 8.0 g/m^2. It would appear that the original targeted density of 7.0 g/m^2 was conservative.

Ideally, a temporary, but relatively sophisticated, smolt enumeration facility should be erected at the outlet of Silver Lake or in lower Silverhope Creek. This would permit monitoring and enumeration of smolt/presmolt emigration from the lake, so as to best evaluate enhancement activities in terms of smolt output.

Preparations are currently being made for the release of 150,000 summer run steelhead fry to Silverhope Creek in 1982.

Ongoing evaluation and assessment (including creel census) of this project becomes a regional responsibility in 1982/83.

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Improvement Section,
Fish and Wildlife Branch,
Victoria.

Coquihalla River Steelhead

The Coquihalla River is located 120 km east-northeast of Vancouver and flows into the Fraser River at Hope.

This system has been under study by SEP since 1976, when it was recommended that prior to any enhancement work, the rearing capability of the mainstem and unsampled tributaries should be assessed. An intensive, extensive salmonid production census has been carried out on this system since 1977.

The objectives of the work in 1981 included:

- assessment of summer steelhead fry density after stocking
- monitoring "changes" in natural rearing capacity
- selecting sites for reversed gravel platforms.

The results of trial saturation of hatchery fry (from the Fraser Valley trout hatchery) into a wild environment will provide guidance for future fish management options such as stocking rates, increasing release size of fry and de-emphasizing the more costly hatchery smolt releases. The main reason for the project is to increase production of wild summer run steelhead and improve adult returns to the valuable sport fishery. The stream is special to Lower Mainland anglers since it provides the best summer steelhead fishing within a reasonable distance of Vancouver.

The available prime rearing habitat may be capable of yielding a significantly greater number of steelhead smolts. Forty-seven hectares of low-flow rearing area, which lies above a partial obstruction, is estimated to yield 23,500 smolts, given that the carrying capacity has not been radically altered by logging, pipeline development, etc. With a 75 percent exploitation rate, the escapement or return to the stream would be 900 adults, or roughly six times the present average return of 150 adults. The fry stocking program holds considerable promise for cost-effectiveness and preferred wild fish production. With reduced commercial and native interception of adults, the Coquihalla may see near historic numbers of 1,500 to 2,000 each year.

Following investigation in 1980, a pilot fry stocking program, involving 10,000 steelhead fry (Coquihalla River brood stock raised at Abbotsford), was carried out. Ten lots of 1,000 early fry (39.4 mm fork length, 0.6 g) were released at selected index sites in mid-June 1981.

Population estimates at the ten index sites, plus one additional "control" site, were completed by electroshocking. Conditions for census were ideal. A physical survey was completed on Karen Creek in November to establish eight gravel platform sites as instream mitigation. Preliminary analysis of field data was completed for this report; densities were compared to measured maximums per site for qualification and interpretation.

Preliminary results include:
- fry abundance (by virtue of artificial and natural recruitment) was considerably greater in 1981 compared to previous years (1977-1980)
- fry density ranged from 0.2 to 0.9 fry/m^2 ($\bar{x}$ = 0.5 fry/m^2); the mean density appears to be three times higher than the overall maximum previously measured
- there appeared to be a general improvement in abundance of benthic insects; this may be due to the large flood in late December 1980, which removed much of the "fines" in the gravel
- steelhead yearling captures are down considerably in keeping with a very poor 1980 year class of fry; the results have demonstrated a greater rearing capacity than that defined by previous measures.

There will be a small increase in fry release in 1982.

In 1982, 30,000 unfed steelhead fry will be released during decreasing spring/early summer flows. The stocking program assessment will be continued--more effort will be spent on qualifying changes in yearling (age 1+) abundance as a result of the 1981 fry plant and winter floods.

If the stocking program proves successful and there is some resolution of the commercial/native interception problem, steelhead anglers are likely to benefit by the increased wild adult returns in 1984 and 1985. The present wild adult returns provide the mainstay of the fishery.

Contact: Ron Ptolemy, Fisheries Biologist, Fish Habitat Improvement Section, Fish and Wildlife Branch, Victoria.

Nicola River Enhancement Assessment

The Nicola River originates on the Thompson Plateau, approximately 20 km northwest of Kelowna. It flows north and west through Douglas and Nicola Lakes and empties into the Thompson River near Spences Bridge.

The largest of three major tributaries to the Thompson River below Kamloops Lake, the Nicola River system is known to support significant, but severely-depressed stocks of steelhead, chinook, coho and pink salmon. Recent conflicts between industrial, agricultural and domestic water users have caused concern over serious low summer flow problems in the Nicola valley. As a result, local groups have promoted a major water use study, while the Ministry of Environment has chosen the Nicola basin as a priority area for the development of a strategic management plan. In response to the growing fisheries information needs of SEP, the Ministry of Environment's Planning Branch (Strategic Planning), and the locally-initiated water use study, a major basin-wide fisheries investigation was undertaken during September and October, 1980. This project was designed to determine the potential for restoration and improvement of salmonid streams in the watershed and was intended to last for three consecutive years (1980-1982). The second year of assessment was undertaken in August and September 1981. Study objectives were to:
- identify the distribution and relative importance of salmonid spawning and rearing areas in the mainstem Nicola and major tributaries through a

census of juvenile fish
- relate existing production to habitat capabilities and constraints while identifying enhancement opportunities for salmonids.

More specific objectives were to:
- improve efficiency of deep water sampling in the mainstem Nicola
- investigate theories on mass downstream migration of chinook and steelhead presmolts during the summer period
- extend sampling to areas not covered adequately by the 1980 assessment.

In 1981, these tasks were completed:
a) Stock assessment - Fish sampling was conducted at a total of 50 sites in the Nicola River, including tributaries. Thirty of the 1980 sites were resampled in 1981 to allow direct comparisons to be made between consecutive years. Twenty new sites were established in previously-unsampled areas such as Clapperton, Quilchena and upper Maka Creeks, and in areas where the information collected in 1980 was inadequate. Fish populations (species and age) were calculated at each site, and estimates of total standing crop and potential smolt yield were developed. Age and growth information from scales was used to support the 1980 findings on life-history sequences and the role and relative importance of tributary streams to overall fish production.

b) Deep water sampling - Considerable effort was expended to develop seining as a viable technique for quantitative sampling of deep water habitats. This technique was employed to monitor changes in juvenile densities between early August and mid-September at two locations in the mainstem Nicola to investigate presmolt outmigrations.

c) Irrigation diversions - Discharges were measured in Guichon and Clapperton Creeks to determine the proportion of water entering major unscreened irrigation diversions.

d) Habitat classification - Aerial overviews of Guichon and Clapperton Creeks were made by helicopter.

Results

Tests indicated that overall salmonid densities at all index sites sampled in 1981 were not significantly different than in 1980.

The 1981 steelhead fry population was estimated to be slightly lower in the Nicola River than in 1980, but higher in Spius and Maka Creeks. Densities of age 1+ parr were considerably higher in 1981, particularly in the mainstem river as a result of a relative abundance of fry in 1980 (i.e. a strong brood year, as indicated by Thompson River angler reports during fall 1979).

The Nicola River appears to be a "catch basin" for fish which became displaced from tributary streams during extreme floods. This is evident from a wide variety of scale (growth) patterns seen in yearling and older trout captured in the Nicola during 1981 (following extreme floods in December 1980). This wide range of growth patterns was not as evident in parr captured during 1980 in the mainstem. Extremely low parr densities in the Coldwater River during 1981 are further evidence of displacements by floods.

With increases in escapement between 1979 and 1980, juvenile chinook populations were expected to be larger in 1981. During September 1981, however, juvenile chinook populations were 50 percent lower in the mainstem Nicola River and lower Spius Creek than in 1980, either as a result of winter floods (displacement) or of summer outmigration of presmolts. The latter is strongly indicated by repeat sampling at two sites (i.e. decreasing densities of chinook, but not rainbow trout, suggest that perhaps 70-90 percent of the chinook present in early August left the system prior to mid-September). Indirect smolt production may be a major component in overall chinook smolt production from the Nicola River.

As in 1980, juvenile coho populations were limited to the upper Coldwater River and Maka Creek (none were captured in the Nicola River). Some juvenile chinook were found upstream of Douglas Lake, altering current knowledge regarding the extent of anadromous upstream migration.

Concerns regarding excessive extraction of water from Guichon and Clapperton Creeks by means of large unscreened irrigation diversions were substantiated by a series of flow measurements during September, 1981. Fisheries potential in these streams (i.e. steelhead and coho production) is greatly reduced by obstructions resulting from present irrigation practices (i.e. wing-dams and excessively low flows prevent both upstream and downstream movements of fish).

Preliminary enhancement recommendations have been made to commence stocking of steelhead fry in Maka and Spius Creeks. Opportunities for improving anadromous fish production through habitat protection activities have been outlined for a number of small tributaries to the Nicola River including Skuhun, Shakan, Nuaitch, Guichon, and Clapperton Creeks.

In 1982, providing funds can be secured, assessment in the Nicola will continue for a third and final year. A slightly higher level of assessment is planned in order to address a number of specific concerns uncovered by the previous two years of assessment. Of particular concern is the presmolt outmigration of both chinook and steelhead juveniles to the Thompson River during summer. The relative importance of outmigrants to overall smolt production must be understood before total production potential can be determined.

In addition to providing clear direction to future fisheries enhancement in the Nicola and answering information needs of the Nicola Valley Water Management Study, this project is both opportune for and fundamental in development of a provincial Ministry of Environment strategic plan for the Nicola Planning Unit. This plan will be the eventual "blueprint" for coordinated management of all environmental resources in the area.

Contact: Dale Sebastian, Fisheries
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Improvement Section,
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Victoria.

Coldwater River Assessment

The Coldwater River is a major tributary of the Nicola River, with its confluence at Merritt, in the southern Interior of B.C.

The project is designed to obtain additional information on variability in annual recruitment of chinook and coho salmon, rainbow (steelhead) trout and Dolly Varden char in relation to carrying capacity of the mainstem Coldwater River and its largest tributary, Juliet Creek.

This information has been used to identify important habitat relative to mitigation opportunities resulting from proposed construction of the Hope-Merritt Highway through portions of the Coldwater River valley. The information is also important for ongoing stock assessment and enhancement investigations in the Nicola system in relation to SEP, and the provincial Ministry of Environment strategic planning objective of improved management of aquatic resources throughout the Nicola Basin. This was the fifth consecutive year in which the Coldwater assessment was undertaken.

Six electrofishing study sites were examined, five in the mainstem and one in its tributary, Juliet Creek. Five of these may be considered as index sites, as they have been sampled in the previous four years (i.e. 1977-80). The primary value of repetitive (annual) sampling at these same locations is that a better appreciation of a particular habitat's ability to support juvenile fish (i.e. its carrying capacity) will emerge, assuming that recruitment by the major species is variable over time (i.e. in a year of particularly good escapement, rearing habitat may be "saturated" with fry, so that late-summer juvenile densities are a more accurate reflection of habitat quality rather than poor, initial seeding rates).

Salmonid species in the Coldwater system include chinook and coho salmon, rainbow (steelhead) trout, Dolly Varden char and mountain whitefish.

Although field data are presently being summarized and interpreted, some preliminary results are apparent. A total of 175 juvenile salmonids, representing three age groups, were sampled in early August, 1981. Consistent with past years, rainbow trout represented the largest component of the pooled catch (74 percent), followed by coho (23 percent), chinook (two percent) and Dolly Varden (one percent). It was obvious from study-site catch results that the December 26, 1980 flood was devastating on salmon egg-to-fry survival in the Coldwater River, as reflected in the lowest mean coho and chinook fry densities recorded at index sites over the five-year monitoring period. The overall mean steelhead fry density was also the lowest in the monitoring period, but cannot necessarily be attributed to the flood, because steelhead are predominantly April-early June spawners in the Coldwater system. However, high suspended sediment levels resulting from pipeline companies' work in the river in March and early April could have affected steelhead spawning success later in the spring (i.e. more silt being transported and deposited throughout the system).

Results from the five-year assessment program are expected to contribute to appropriate mitigation strategies during future highway construction and complement and improve five-year knowledge of steelhead and salmon production in the Nicola system (i.e. stock recruitment expectations).

No additional juvenile population census is currently planned for the Coldwater drainage in 1982. With eventual construction of the Hope-Merritt Highway, some additional population monitoring may be undertaken for comparison with the baseline (pre-construction) data collected from 1977 to 1981.

Meetings with Ministry of Highways staff to plan and approve appropriate mitigation designs will likely take place in 1982.

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Habitat Improvement Section,
Ministry of Environment,
Victoria.

Mid-Fraser River/ Thompson River Reconnaissance

Nicola-Coldwater River Systems

Feasibility studies continued on this system, including preparation of a report outlining the groundwater potential in this area.

Thompson River Mainstem

Preliminary analysis of water quality data for the Thompson River below Kamloops Lake was carried out, due to anticipated problems related to the toxic effluents produced from the pulp mill and sewage disposals at Kamloops.

Contact: George Nielsen, Senior Engineer, Engineering; Bruce Shepherd, A/New Projects Coordinator, Enhancement Operations.

West Fraser Steelhead

The West Fraser steelhead program was initiated in 1979 by the Fish and Wildlife Branch, but funded entirely by SEP.

The program arose out of the need to obtain biological information about salmonid populations in the little-known streams tributary to the west bank of the Fraser River, between North Bend and Lillooet. The Nahatlatch, Stein, Seton and Bridge Rivers, and Texas Creek were examined.

Steelhead was the focal species of the program, but all anadromous salmonids were examined and evaluated. Fisheries agencies involved in SEP had virtually no prior knowledge of basic life histories, species mix, abundance, distribution or enhancement opportunities for any of the systems studied.

Age, growth, distribution and species mix have been determined for steelhead in the Nahatlatch, Stein, Seton and Bridge River systems. Presence, distribution and relative abundance of all salmonids have been determined for each river system.

Enhancement opportunities were identified on the Nahatlatch and Yalakom (Bridge River tributary) Rivers which, if acted upon, could produce significant future benefits to steelhead, chinook and coho populations.

Enhancement opportunities on the Nahatlatch involve logjam removals and fry colonization of headwater rearing habitat. Opportunities on the Yalakom include removal of a small obstruction and headwater colonization; approximately 35 km of prime, highly-productive spawning and rearing habitat could be colonized and made accessible to adult steelhead, chinook and coho.

A detailed technical report is being written and will be completed by March 31, 1982.

Contact: John Cartwright, Regional Fisheries Biologist, Fish and Wildlife Branch, Ministry of Environment, Kamloops.

Birkenhead Hatchery

Birkenhead hatchery is located on the Birkenhead River, approximately 2 km north of Mount Currie. The Birkenhead is part of the Fraser River system, connected through Lillooet and Harrison Lakes.

Production from this chinook facility will upgrade the native food fishery. The sport fishery, which is presently closed on the Birkenhead, will also benefit.

Escapement to the Birkenhead was very poor in 1981--estimated at only 150 adult chinook. Chinook donor stock, caught by anglers, was held in an earthen pond. Holding mortalities were minimal. A total of 70,788 eggs were placed in Heath trays (the gravel incubator was not used this year). Approximately 69,000 fry will be ponded in January, 1982; 10,000 of these fry will be overwintered and released in the spring of 1983.

Contact: Bill Foye, Stock Enhancement Officer, Enhancement Operations; Colin MacKinnon, Unit Head, Fraser River, Northern B.C. and Yukon Division.

South Thompson Reconnaissance/Feasibility

Shuswap River

Studies are continuing in order to determine the feasibility of constructing a salmonid enhancement facility on this system near Shuswap Falls.

Close liaison is being maintained on this proposed project with B.C. Hydro and Power Authority, which owns and operates a hydroelectric installation at that location.

A pilot facility may be built inside or adjacent to the powerhouse below the dam. This pilot could be used to test the effectiveness of outplants of two-gram chinook salmon fry into unutilized rearing areas above the dam.

Contact: George Nielsen, Senior Engineer, Engineering;
Bruce Shepherd, A/New Projects Coordinator, Enhancement Operations.

Public Participation Projects

Contact: Dennis Demontier, SEP Community Advisor, Kamloops.

Salmon Arm Fish and Game Club

Club members constructed and operated one incubation box on Canoe Creek last year. Spawning platforms were also installed. However, no eggs were taken due to poor escapement.

Salmon Arm Secondary School

The students at Salmon Arm Secondary continued operating two 50,000-egg incubation boxes and improving habitat. In the spring, 5,500 fry emerged from 8,000 coho eggs planted at Tappen Creek. However, at the other incubation box on Salmon River in the Shuswap watershed, no fry emerged from the 3,000 eggs planted.

The students also transplanted 1,700 fry from Tappen Creek to Canoe Creek in the spring of 1981, and created new spawning areas. No eggs were taken in the fall of 1981 due to poor escapements.

Charles Bloom Secondary School

The students constructed and installed a 50,000-egg incubation box near Lumby. In May and June, 550 fry emerged from the 4,000 coho eggs planted in November, 1980.

No eggs were taken in the fall of 1981 because of poor salmon escapements.

The project provided students with hands-on experience and helped them understand facets of resource management.

Eagle River Hatchery

Design is well underway for the first stage of a central hatchery for chinook and coho on the Eagle River, 28 km east of Sicamous. Start-up of the facility is slated for fall of 1982.

This facility will handle one million eggs, representing four groups of chinook and coho stocks from the Eagle and Salmon Rivers. It is designed to provide information on outplanting potential and imprinting strategies, as well as information on the impact and treatment of hatchery effluent in a dry climate. In 1981, significant effort was expended to ensure that the targets were sufficient to allow evaluation of the success of outplants of two-gram coho fry and the imprinting of both coho and chinook to the two rivers.

The Eagle River facility has been planned so that it can be easily expanded to deal with all South Thompson stocks, or modified to shift its emphasis to other species or stock mixes.

In support of this new facility, juvenile and adult biobaseline studies were carried out by consultants on the Adams, Eagle, Salmon and South Thompson mainstem systems.

Contact: Wayne Peterson, Senior Project Engineer, Engineering; Bruce Shepherd, A/New Projects Coordinator, Enhancement Operations.

Thompson River Reconnaissance

Early in 1981, potential coho incubation sites were located on Lion, Seymour and Tappen Creeks. All are tributaries of the North or South Thompson Rivers.

To date, hatchery potential of each of these sites has only been assessed on the basis of water temperature and discharge suitability. Both Lion Creek, near Avola, and Tappen Creek, on the outskirts of Salmon Arm, are evaluated as good development projects. Unfortunately, futher assessment in 1982 is likely to be discontinued because of budgetary constraints.

Contact: Mel Sheng, Biological Technician, Special Projects.

Thompson River Steelhead

An intensive radio-tagging program on adult Thompson River steelhead in the early years of Phase I of SEP provided the Fish and Wildlife Branch with critical life history information on these fish and allowed development of a sound enhancement plan for the river system. Production targets were developed, based on the natural productive capability within Thompson River tributaries downstream from Kamloops Lake. These targets would ultimately see production of up to 6,000 additional steelhead by natural spawning and rearing. Additional production could be obtained in future years by augmenting natural production with hatchery-produced smolts.

All Thompson River steelhead efforts during 1981 were directed toward production of steelhead, assessment of 1980 colonization or habitat improvement, and monitoring of angler success and effort.

The 1981 year began with steelhead brood collections in Bonaparte and Deadman Rivers. This activity provides the egg supply required for operation of the provincial Loon Creek hatchery at full capacity, with annual production of 40,000 smolts for Bonaparte River. Fry in excess of smolt production needs are used for colonization and natural rearing in the streams of origin (either Bonaparte or Deadman).

Chinook salmon brood collections were made, resulting in approximately 160,000 chinook eggs for Loon Creek hatchery. Design capacity is 150,000. Fry will be colonized into upper Bonaparte River in May 1982, as was done in 1981. This program will continue for at least two more years to establish one complete cycle from SEP production. When the first adults return (July-August 1984), a decision made on whether to temporarily transport them above a lower-river, six-metre obstruction and to subsequently (in Phase II) remove the obstruction.

Three self-cleaning screening devices were installed in irrigation ditch intakes on Criss Creek, Shakan Creek and Nicola River, where major losses of steelhead fry were documented. In one ditch alone on Shakan Creek, 35,000 to 50,000 fry were lost annually onto fields prior to installation of a screen.

The Thompson River creel survey was repeated from October 1 to the closure of steelhead fishing on December 31. Main objectives were to monitor angler use and catch and to recover heads from steelhead which were nose-tagged as juveniles in Deadman River by federal SEP crews in 1978. Nine marked fish were recovered; several others were reported, but not verified. A detailed creel survey report is being prepared.

More detailed reports on all activities will be completed by April 1982.

Contact: John Cartwright, Regional Fisheries Biologist, Fish and Wildlife, Ministry of Environment, Kamloops.

Louis Creek Assessment

Louis Creek, a tributary to North Thompson River, is near Barriere (54 km northeast of Kamloops).

The project was initiated in 1980 to increase and sustain coho and chinook production in a productive stream in B.C.'s Interior. The prime objectives of the project are:

- to determine the present population of salmonid juveniles in the stream during low summer flows
- to determine the potential carrying capacity of presmolts in the stream
- to determine the change in carrying capacity as it relates to discharge.

If the results demonstrate a large amount of vacant rearing habitat for coho and chinook salmon, a SEP pilot facility may be located in the headwaters of Louis Creek to seed fry into habitat that is currently underutilized; the mainstem length is 48 km and rearing area is almost 30 hectares.

In August 1981, a biophysical assessment of Louis Creek was conducted. Population census was by total removal (electroshocking and seining); habitat measurement and stream discharge metering were also carried out. Fourteen sites were sampled. Temperature was continuously monitored by thermograph. All major tributaries were surveyed, with notation made on flows, habitat conditions, and measured fish abundance. Casual interviews were carried out with stream-side residents for temporal information on fish numbers, migration timing, and stream problems. A special low-altitude flight was done for air photo analysis of fish habitat and reach separation.

Since much of the available habitat throughout the middle and lower reaches of the mainstem is supporting few salmonids, it is unlikely that an appropriate analysis can be made on carrying capacity changes as a function of low flows. The stream must be fully saturated by fry recruits so that changes in fish density are due to changes in flow. Flows in all drainages were somewhat higher compared to historic minimums recorded by Water Survey of Canada. High-to-exceptionally-high numbers of salmonids were encountered in the upper reaches where recruitment was not limiting. An analysis of habitat quantity/quality vs. fish abundance is currently underway so that potential fish production benefits can be accurately described prior to construction of any enhancement facilities.

In 1982, SEP will consider the feasibility of a pilot satellite facility on Louis Creek to produce coho and chinook fry.

Wild coho and chinook salmon production will increase, provided fry stocking is undertaken. The beneficiaries will be the commercial, sport and native fisheries on the coast and Fraser River/Thompson River system.

Contact: Ron Ptolemy, Fisheries Biologist, Fish Habitat Improvement Section, Ministry of Environment, Fish and Wildlife Branch, Victoria.

Louis Creek Coho Enhancement

Louis Creek is a tributary of the North Thompson River. In 1981, a coho carrying capacity study was conducted on this creek. The results indicate that coho production is only at six percent of stream capacity. During the study, several kilometres of prime rearing habitat were found devoid of coho fingerlings. From the 1981 assessment, it is estimated that only 13,000 coho smolts will be produced. In order to utilize available habitat, a public involvement hatchery project will be constructed on Christian Creek, a tributary of Louis Creek. This hatchery will be committed to the production and seeding of coho fry in Louis Creek. The project will operate as a pilot project in 1982 to assess site suitability and hatchery skills of the group involved. Approximately 50,000 to 100,000 eggs will be incubated, and the resulting fry will be partially reared and then planted throughout the system.

In 1981, a well was drilled in the headwaters of Christian Creek in order to increase summer flows. Although an artesian flow was found, discharge was only 11.25 to 15 L/s. Water quality was marginal for hatchery use, due to high levels of iron, manganese and ammonia. Ways to rectify the water quality problem will be explored with new aeration and filtration techniques. If the new techniques are successful, the available well discharge may be used, at a future date, for hatchery expansion.

Contact: Mel Sheng, Biological
Technician, Special Projects.

North Thompson Reconnaissance/Feasibility

Reconnaissance/feasibility efforts continued through 1981 to identify specific facility sites, with juvenile and adult biobaseline studies completed on the Blue, Finn, Lion, Raft, and North Thompson mainstem systems. Biological strategy for a major facility, which would incorporate multi-stock outplants of both chinook and coho juveniles up to five grams in size, was also developed in 1981.

Finn Creek

Finn Creek flows in a southwesterly direction and discharges into the North Thompson River, some 15 km north of Avola.

Feasibility studies were continued on this system, including detailed topographical surveys and mapping for preliminary engineering designs of proposed facilities, and a groundwater exploration program. The studies also included monitoring stream discharge, temperature and water quality.

Lion Creek

Lion Creek, a tributary of the North Thompson River, is located between Avola and Blue River. Feasibility studies, including the monitoring of stream discharges and temperatures, were continued on this system during 1981.

Mahood River

Mahood River is a tributary of the Clearwater River, north of Clearwater. A groundwater exploration program (including the monitoring of groundwater temperature and quality), plus aerial photography and topographical mapping of the proposed enhancement site were carried out on this system in 1981, as part of the feasibility study.

Close liaison is being maintained with the Ministry of Lands, Parks and Housing concerning the development of this project.

Christian Creek

Christian Creek, a tributary of Louis Creek, originates from groundwater sources immediately east of Heffly Lake.

A groundwater exploration program, undertaken near the headwaters of this system, confirmed the presence of a favorable groundwater source in this area.

The temperature and discharge of the groundwater outflows are being monitored for potential use in a small incubation facility to enhance the coho runs in Louis Creek. Increased water flows to Louis Creek would help mitigate the extremely low water levels in the creek during the summer and provide more suitable coho rearing areas.

Contact: George Nielsen, Senior Engineer, Engineering; Bruce Shepherd, A/New Projects Coordinator, Enhancement Operations.

Public Participation Projects

Contact: Dennis Demontier, SEP Community Advisor, Kamloops.

Nicola Indian Band
This group constructed and installed two incubation boxes for coho on the Nicola River. No eggs were taken due to poor escapement.

About six Band members participated in this project.

Merritt Rod and Gun Club
The Club operated an incubation box on the Nicola River. During the fall, 5,500 chinook eggs were taken. Ten people were involved in the project during 1981.

Lumby and District Wildlife Assn.
Two 50,000-egg incubation boxes were built and installed at Beaverjack Creek. Four thousand eggs from Harris Creek yielded 550 coho fry in May and June of 1981. In the fall, only 300 chinook eggs were taken due to poor escapement.

About 20 people were involved in this project.

Lillooet Secondary School
The students' incubation boxes on the Yalakom River turned in a good egg-to-fry rate in 1981. Of the 15,000 coho eggs from Bridge River planted in 1980, 10,500 emerged as fry.

In the summer, the students built rearing troughs.

In November, 1981, they planted 34,000 eggs from Bridge River coho into their boxes on the Yalakom River.

The project, continued from last year, has established a coho run on the upper Yalakom River, a tributary of Bridge River. It gives students practical experience, supplementing Salmonids in the Classroom, SEP's educator's package.

Kingfisher Community Club
Club members constructed and installed two 50,000-egg incubation boxes for salmonid enhancement on the Shuswap River system. In the fall, 8,500 chinook eggs and 5,000 coho eggs were taken from Kingfisher Creek.

About 20 people were involved in the project in 1981.

North Kamloops Elementary School
North Kamloops Elementary School students continued with their project at Louis Creek, a tributary of the North Thompson River. Plans to build and operate a 50,000-egg incubation box at a new Kamloops pulp mill fell through when the pulp mill was cancelled. In the fall of 1980, 10,000 coho eggs were planted in the instream incubation box built by the students; 3,000 fry emerged in the spring of 1981. In November, the students planted 6,000 coho eggs in a Heath tray unit at the school; by the end of the year, egg development was progressing well.

North Kamloops Secondary School

In May, 1981, 1,500 coho fry emerged from 3,000 eggs planted at the school's incubation box at Tranquille Creek, which flows into Kamloops Lake. This project ended when the fry were released.

Arthur Stevenson Elementary School

The students from this Kamloops school continued their efforts in enhancing coho stocks in Noble Creek (a tributary of Louis Creek) and improving habitat conditions. The students had constructed and installed three 3,000-egg incubation boxes on the creek in 1980. In 1981, 3,000 coho fry emerged from 9,000 eggs planted in 1980. In November, 3,000 eggs were taken.

Heffley Creek Elementary School

Pupils constructed and operated a 3,000-egg incubation box for coho in the classroom. However, no eggs were taken during 1981.

Barriere River-D. Smith

One incubation box for coho was constructed under this project; however, no eggs were taken due to poor escapement.

A Lillooet Secondary School student transfers fry to the Yalakom River.

Blue River Lioness Club

Club members operated a 50,000-egg incubation box at Cook Creek, a tributary of the North Thompson. Due to water pipeline problems, no fry emerged in the spring from the 3,000 coho eggs planted. However, the box was improved, and 3,000 more coho eggs were taken in November.

Four people were involved in this project in 1981.

Valemount Kinsmen

At Swift Creek, six Kinsmen operated an incubation box, and 3,100 chinook eggs were taken. Water intake problems, however, caused the loss of all eggs.

Hutda Camp, B.C. Corrections Branch

This group installed and operated a small hatchery facility on the Chilako River near Prince George. Although 6,800 chinook eggs were taken in late August, all were lost due to high water temperatures. In 1982, the group will test a new water source, and incubate sockeye eggs.

Spruce City Wildlife Association

In May, the Association released 7,000 (four-gram) chinook fingerlings into Slim Creek. The fingerlings emerged from 10,000 chinook eggs planted in the Association's incubation box on the Salmon River during the summer of 1980.

No eggs were taken in the fall of 1981 because of lack of a location for the incubation box.

This Prince George Association has been extremely active in salmonid enhancement over the past few years. Through its project, the Association hopes to enhance local salmonid stocks and to raise the awareness of the general public of the importance of the salmonid resource.

Loon Creek Hatchery Expansion

Loon Creek hatchery is located on Loon Creek (tributary to the Bonaparte River), 23 km north of Cache Creek. It has been operated by the Fish and Wildlife Branch (FWB) since the 1950s and was expanded in 1979-1980 in a joint SEP/FWB venture to accommodate chinook salmon and to increase steelhead trout production.

Adult chinook salmon cannot negotiate the falls below Cache Creek and utilize the upper reaches of the Bonaparte River for spawning or rearing. Consequently, adult donor stock is captured by angling below the falls and held until maturity in gravel ponds at the facility. Eggs are taken in mid-August to mid-September. The resulting fry are then reared in the hatchery building. The facility consists of an incubation room, eight rearing troughs for chinook salmon, and three circular ponds for steelhead trout.

In 1980, 55,000 chinook eggs were collected and incubated in Heath trays. The fry were coded-wire tagged and released throughout the Bonaparte River in late April, 1981, thus utilizing the previously unused rearing areas of the river.

Approximately 39,058 juvenile steelhead, originating from the Deadman River (1980 brood), were released into the Bonaparte River in 1981. Average size of these fish ranged from 17.4-60.2 grams. At the end of the year, another 39,160 Deadman/Bonaparte steelhead presmolts were rearing at the facility; these fish will be released in the Bonaparte River in April 1982.

A sampling program carried out by Fish and Wildlife in September indicated that growth of these fry in the river was quite good. The smolts are expected to migrate to sea in the spring of 1982.

Contact: Dennis Graf, Senior Fish Culturist, Loon Creek Hatchery, Cache Creek; Gordon Berezay, Support Biologist, Enhancement Operations.

Bonaparte River Steelhead

In 1979, an evaluation of the salmonid rearing capacity in the Bonaparte River in relation to proposed future SEP activities was conducted. Such plans included modification of the Bonaparte River falls to allow anadromous salmonids access to over 140 km of upstream mainstem habitat, and development of steelhead and chinook production capability at the Loon Creek hatchery. The first chinook and steelhead production from the Loon Creek hatchery were available for release in the spring of 1981. Release sites in the Bonaparte River were identified and the success of releases in terms of juvenile rearing and growth was evaluated.

Stocking Program

Release sites were chosen in consultation with Loon Creek hatchery and DFO staff. Roughly 12,000 steelhead subsmolts were released in mid-April at three sites in the Bonaparte River between Chasm Creek and the Rayfield River. Stocking methods included two scatter releases and one point release, all with road access. Approximately 27,000 steelhead smolts were released in the lower Bonaparte (below the falls) in April and May. Approximately 50,000 chinook fry were released in May at six sites between Young Lake and Loon Creek. A variety of point and scatter releases was conducted.

Assessment Program

Population estimates were conducted at 24 sites throughout the Bonaparte, from Young Lake to Ashcroft, in September and in October, 1981. Emphasis was placed on sampling at and near release sites. All population estimates were conducted by electrofishing. Two snorkel surveys were also conducted. A large number of chinook and steelhead scale samples were collected at the times of release and capture. Temperature records were collected at two locations with thermographs.

Preliminary results indicate that the stocking program was successful. More detailed data analysis will address survival and growth from release to late summer.

Chinook

The majority of 196 Loon Creek chinook was captured at and near release sites. It appears that some chinook did move downstream from release sites, probably in relation to availability of preferable habitat. There did not appear to be mass movements downstream, as indicated, for example, by the lack of adipose-clipped chinook in and around Rayfield River. All captures here were unclipped fish, only seven or eight km below the nearest marked-fish release site. Mean length of the fish had increased from 61 mm at release to 89.6 mm at capture, with an increase in mean weight from 2.7 g to 6.9 g.

Steelhead

A total of 37 steelhead were captured. Again, captures were concentrated at and near release sites, although dispersal may have been quite substantial at the point release site. Mean length increased from 117 to 140.3 mm from April to September.

In 1982, chinook fry and steelhead yearling (smolts and grade downs) releases will be continued. Evaluation of releases will continue as well.

Contact: Dave Tredger, Fisheries Biologist, Fish Habitat Improvement Section, Fish and Wildlife Branch, Victoria.

Chilcotin River Steelhead Enhancement Reconnaissance

Regional fisheries managers (Cariboo) have identified management problems and goals for Chilcotin River steelhead stocks. The present strategy emphasizes identification and exploitation of opportunities for natural or semi-natural enhancement. As part of the enhancement program, a pilot hatchery facility was developed at Hanceville. Evaluation of opportunities for release of steelhead fry in the Chilcotin River system was initiated in 1980, with the assessment of the Little Chilcotin River and Elkin Creek. The 1981 evaluation was directed at the Chilko River, from Chilko Lake to the Chilcotin confluence near Redstone, 90 km west of Williams Lake. Specific objectives of the project were to determine the carrying capacity of the Chilko River for steelhead fry and to identify any opportunities for steelhead fry release.

In 1981, the carrying capacity of steelhead fry in the Chilko River was assessed. Electrofishing was used to estimate fish populations at 20 sites in the Chilko River system in October 1981. Sample sites consisted of edge habitat only, as sampling was solely aimed at estimating fry populations. Steelhead fry (from Hanceville) were stocked at two locations in the Chilko River in mid-August; these locations were more intensively sampled to gain insight into probable fry densities at carrying capacity.

The steelhead fry population in the Chilko River was estimated at roughly 650,000. Because population densities were considered at or very near saturation levels, opportunities for fry release were therefore limited. Predicted smolt yield and adult return data suggest the major limiting factor in adult escapement was the commercial interception of steelhead.

Evaluation of steelhead fry stocking in the Chilcotin River system will be conducted in the late summer of 1982; steelhead fry from the Hanceville facility are then expected to be released into the Little Chilcotin River.

Contact: Dave Tredger, Fisheries Biologist, Fish Habitat Improvement Section, Fish and Wildlife Branch, Victoria.

Chilcotin Steelhead Stocking

The Chilcotin River historically supported one of British Columbia's most popular steelhead sport fisheries. However, in recent years, steelhead stocks in this river have declined, and angler harvests have been restricted accordingly. Mixed stock commercial fisheries have been blamed for declining escapements.

This project was undertaken to increase the smolt output and thereby restore angling activity to former levels.

A pilot steelhead fry production and stocking project was undertaken on the Chilcotin River system during 1981, using a makeshift hatchery facility supplied by groundwater from a small tributary stream.

A total of 16,520 eggs were obtained for the program by electroshocking ripe donor stock from spawning areas on the Chilko River. By mid-August, 13,870 fry (averaging one gram each) had been produced. These fry were transported to the Chilko River and released.

A follow-up survey of fry densities and growth at the release sites was conducted during early October, in conjunction with a complete assessment of fry carrying capacity in the Chilko.

Steelhead escapements to the Chilcotin system are assessed annually by performing aerial counts of spawners in the Chilko River during late May. The 1981 count was 122, and the total escapement to the system was estimated at 700 fish.

A creel census was also undertaken to provide data on run size and angling pressure. Between Oct. 1 and Dec. 31, 1981, 331 angler days were expended on the Chilcotin system and 108 steelhead were landed, of which 72 (approximately 67 percent) were released.

Contact: Jack Leggett, Regional Fisheries Biologist, Fish and Wildlife Branch, Williams Lake.

Upper Fraser Reconnaissance

Chilko-Chilcotin Rivers

Reconnaissance surveys were undertaken on the Chilko and Chilcotin River systems to identify opportunities for salmonid enhancement, and three sites were subsequently identified as having potential: the Taseko River, the confluence of the Chilko and Little Chilcotin Rivers, and the Chilanko River (near Puntz Mountain airbase). The New Projects Unit now is monitoring the water quality and temperature at these sites.

Contact: George Nielsen, Senior Engineer, Engineering; Bruce Shepherd, A/New Projects Coordinator, Enhancement Operations.

Quesnel River Hatchery

This facility, located at the outlet of Quesnel Lake, near Likely, and 66 km northeast of Williams Lake, has commenced operation. The facility began operations in the fall of 1981 with a pilot egg-take of 98,200 chinook eggs.

Operation of this hatchery during the 1981 brood year was small-scale, due to construction delays. The brood stock was captured by using beach seines or by drifting gillnets on the spawning grounds of the Quesnel River. The eggs collected were incubated in Heath trays to the eyed stage and the survival rate was 87 percent.

When complete, this facility will have a capacity for 3.9 million chinook eggs, which will be collected from the Blackwater, Bowron, Cottonwood, Quesnel and Willow Rivers and Slim Creek. Some of these donor streams are as distant as 160 km by air from this central hatchery. After the eggs are incubated, the hatched fry will be reared and then transported to their native streams for imprinting prior to release.

The facility consists of 82 Heath-tray stacks, 32 aluminum troughs for rearing fish to two-gram size, and seven concrete raceways for rearing fish to five-gram size. There is an excellent, warm groundwater supply.

When complete, the Quesnel hatchery will have a capacity for rearing 3.9 million juvenile chinook.

There are plans to rear 50,000 Quesnel River fry for one year (to 50-gram size) in channels to be constructed in the Quesnel River.

In mid-December, operation of this facility was contracted out to an environmental consultant firm. This contract will run through to the fry release, expected in early May, 1982.

Contact: Robin Dickson, Stock Enhancement Officer, Gordon Bérézay, Support Biologist, Enhancement Operations; Adrian Rowland, Project Engineer, Engineering.

Upper Bowron Reconnaissance/Feasibility

During the summer of 1980, three pilot incubation and rearing facilities were constructed on the upper Fraser River for examining the feasibility of enhancing chinook stocks on this system.

Reconnaissance in 1980 identified a groundwater-fed channel on the left bank of the Bowron River, approximately 1.5 km downstream of Bowron Lake. Subsequent to this inspection, water quality and temperatures were monitored in 1981, and a biophysical survey of the area was carried out in July by a team of students. Results indicated that the channel water is supersaturated with nitrogen, but with improvements, the channel could be suitable for holding adults and/or for short-term rearing of juvenile fish for the central facility at Quesnel. In the long term, this site may have further potential as a hatchery site.

Contact: Bruce Shepherd, New Projects Coordinator, Enhancement Operations; George Neilsen, Senior Project Engineer, Engineering.

Upper Fraser Reconnaissance

Beak Consultants Ltd. carried out studies on adult and juvenile salmonids on the Holmes, Morkill, Torpy, and Slim systems, which are all tributaries of the Upper Fraser.

Contact: Bruce Shepherd, New Projects Coordinator, Enhancement Operations.

Rankin Creek (Penny) Pilot Facility

This facility was constructed in 1980 to determine the suitability of the site, to evaluate cold-water rearing techniques, and to provide a tagged group of chinook from an upper Fraser facility. The facility is located in the community of Penny, 105 kilometres east of Prince George on the north side of the Fraser River. Initial construction consisted of a 75,000-egg incubation box and a rearing trough hooked up with an aerated, gravity-fed water supply.

In late summer of 1980, 64,000 Slim Creek chinook eggs were brought to the facility. (Slim Creek enters the Fraser River from the southwest, 12 kilometres east of Penny.) In early May, 1981, 63,700 chinook fry emerged from the incubation box and were reared for two months until they reached the two-gram size. These fry were then coded-wire tagged and transported to two release sites on Slim Creek. They were imprinted for 24 hours before release.

Water temperatures during incubation were lower than expected from December to March, causing a later-than-expected fry emergence. Although fry ponded at 3°C showed good feeding response, evaluation of cold-water rearing techniques was not possible, as temperatures rose to above 6°C within two weeks. Water temperatures fluctuate because the groundwater source is five kilometres above the hatchery intake and therefore, subject to environmental change.

During 1981, the Penny facility was expanded to accommodate 300,000 chinook eggs; another incubation box, five eight-tray Heath stacks and three rearing troughs were added.

After a review of the 1980 brood year program, the Department decided to continue this facility and also increase its capacity. During the summer, the water supply pipeline was improved, and the facility was expanded to accommodate 300,000 chinook eggs. Another incubation box, five eight-tray Heath stacks and three rearing troughs were added. In the late fall, a settling basin was constructed for the hatchery wastewater before it returns to Rankin Creek.

Because of the shutdown of the Bowron pilot facility and the construction delays on the Quesnel River hatchery, 103,800 Bowron River and 102,700 Slim Creek chinook eggs were transported to the Penny facility in late summer. Survival rates to the eyed stage were 97 percent for the Bowron River eggs and 93 percent for the Slim Creek eggs. The fry will be reared, coded-wire tagged and imprinted in their native streams upon release in 1982.

Contact: Robin Dickson, Stock
Enhancement Officer,
Enhancement Operations;
George Neilsen, Senior
Engineer, Engineering.

Stuart River Pilot

A pilot facility was constructed on private property, located three kilometres north of the Stuart River, within the village limits of Fort St. James. The objective of this pilot facility was to undertake tests to determine the suitability of utilizing water from an artesian well for incubating and rearing chinook salmon fry.

The pilot facility consisted of a steel building, rearing troughs, aeration and related plumbing facilities.

The experimental rearing program compared growth of groups of fish held in filtered, raw and iron-added water, using approximately 3,000 Slim Creek chinook fry from the pilot hatchery in Penny. The fish fared remarkably well in all water supplies. Growth was suspended when iron levels were above 1 ppm, but the hard nature of the water seemed to protect the fish from toxic effects of high iron. Approximately 2,800 3.5-gram chinook fry were released into Slim Creek in August, 1981.

The results of the tests, although encouraging, were inconclusive as they did not cover the alevin and early rearing stages. It was, therefore, decided that the water supply should be tested for a complete cycle--from early incubation to final rearing stages.

In order to accommodate those requirements, it was necessary to modify the pilot facility. Modifications included: strengthening the structural supports of the building, modifying the plumbing system, plus installing an electrical service, two stacks of Heath trays and two aluminum rearing troughs.

The modified pilot facility was not operated over the 1981-82 winter due to shortage of operations staff and funds.

In addition to the construction of the pilot facility, reports from the 1980 juvenile and adult biobaseline studies were completed in 1981. Although it had been planned to continue with a second year's investigation in 1981, delayed or reduced funds cancelled this specific project.

Contact: George Nielsen, Senior
Engineer, Engineering;
Bruce Shepherd, A/New
Projects Coordinator,
Enhancement Operations.

Table 4

Fraser River SEP Facilities*: Juvenile Releases 1981

Species	Brood	Group	Total Released	% Marked	% Survival	Avg. Size(g)
Blaney Creek Chum Facility[1]						
Chum	1980	Blaney Cr.	235,000	N/A	30	N/A
Inch Creek Hatchery						
Chum	1980	Inch Cr.	946,705	10	46	1.6
Coho	1980	Bell Cr.	37,145	87	91	1.87
Coho	1980	Nicomen Sl.	37,117	99	N/A	2.08
Coho	1980	Inch Cr.	44,496	94	79	1.98
Cutthroat	1980	Fraser R. (Agassiz)[2]	9,000	100	72	58.5
Cutthroat	1980	Fraser R. (Agassiz)[3]	9,300	100		57.5
Fraser Valley Trout Hatchery						
Steelhead	1980	Coquihalla R.	42,857	100		62.5 - 87.0
Steelhead	1980	Alouette R.[4]	4,116	100	77	86.2
Steelhead	1980	Alouette R.	20,860	100		92.6 - 117.6
Steelhead	1980	L. Campbell R.	2,284	100	72	54.6
Steelhead	1981	Coquihalla R.	20,000	0		0.6
Steelhead	1981	Alouette R.[5]	10,000	0		1.6
Steelhead	1981	Alouette R.	18,755	0		1.6
Steelhead	1981	L. Campbell R.	3,500	0		1.8
Steelhead	1981	L. Campbell R.[6]	3,500	0		1.8
Steelhead	1981	Coquihalla R.[7]	65,440	100	N/A	4.5
Steelhead	1981	Silverhope R.	30,000	100	N/A	4.5
Steelhead	1981	Squamish R.[8]	24,300	97	N/A	1.9
Steelhead	1981	Squamish R.[9]	5,000	97	N/A	1.9
Surrey Rearing Ponds						
Steelhead	1980	L. Campbell R.	11,212	90	72	73.5 - 109.9
Cutthroat	1980	Nathan & West Cr.[10]	10,815	100	59	88.9 - 111.1
Cutthroat	1980	Nathan & West Cr.[11]	1,573	100		108.7
Alouette River Correctional Center Hatchery						
Chum	1980	S. Alouette	15,000	N/A	6	N/A
Chum	1980	Blaney Cr.	235,000	N/A	30	N/A

*includes facilities constructed prior to SEP.

Table 4 (continued)

Fraser River SEP Facilities*: Juvenile Releases 1981

Species	Brood	Group	Total Released	% Marked	% Survival	Avg. Size(g)
Chilliwack Hatchery						
Chum	1980	production	845,179	19	19	0.83
Chehalis Band Project						
Coho	N/A	Chehalis R.	2,992	N/A	N/A	N/A
Coho	N/A	Weaver Cr.	366	N/A	15	N/A
Chum	1980	Harrison R.	13,000	N/A	N/A	N/A
Chum	1980	Billy Harris Sl.	1,316,400	N/A	N/A	N/A
Chum	1980	L. Mountain Sl.	484,200	N/A	N/A	N/A
Chum	1980	Jimmy Charlie Sl.	4,100	N/A	0.1	N/A
Chum	1980	Jonnie Mac Sl.	15,200	N/A	25	N/A
Chinook	1980	Harrison R.	39,200	N/A	43	N/A
Jones Creek Spawning Channel						
Pink	1980	Jones Cr.	1,600,000	N/A	N/A	N/A
Chum	1980	Jones Cr.	37,500	N/A	N/A	N/A
Birkenhead Hatchery						
Chinook	1979	supersmolt	14,417	100	59	37.02
Chinook	1980	production	72,413	91	66	3.12
Loon Creek Hatchery						
Steelhead	1980	Deadman R.[12]	39,058	93		17.4 - 60.2
Chinook	1980	Bonaparte R.	55,613	72	85	2.5 - 2.9
Bowron Pilot Facility						
Chinook	1980	Bowron R.	26,500	100	47.3	1.5
Rankin Cr. (Penny) Pilot Facility						
Chinook	1980	Slim Cr.	56,000	N/A	N/A	2

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*includes facilities constructed prior to SEP.

Table 4 (continued)

Footnotes

[1] Last year of operation.
[2] Released into Nicomen Sl.
[3] Released into Stave R.
[4] Released into Marshall Cr.
[5] Released into North Alouette R.
[6] Released into Murray Cr. (Nikomekl).
[7] Released into Upper Silverhope R.
[8] Released into Ashlu R.
[9] Released into Shovelnose Cr.
[10] Released into Serpentine, with 500 each into Nathan and West Cr.
[11] Released into Brunette R.
[12] Released into Bonaparte R.

Table 5
Fraser River SEP Facilities*: Status at December 1981

Species	Stock	Brood	Stage	No. on Hand	Date	Expected Release	
						Number	Site
Inch Creek Hatchery							
Chum	Inch Cr.	81	egg	1,645,000	May 1982	1,300,000	Inch Cr.
Chum	Blaney Cr.	81	egg	1,960,000	April 1982	1,570,000	Blaney Cr.
Coho	Inch Cr.	81	egg	15,000	June 1982	12,000	Inch Cr.
Coho	Bell Cr.	81	egg	52,000	June 1982	42,000	Bell Cr.
Coho	Nicomen Sl.	81	egg	70,000	June 1982	56,000	Nicomen Sl.
Cutthroat	Fraser/Agassiz	81	presmolt	26,970	May 1982	26,000	Nicomen Sl., Stave, Brunette
Fraser Valley Trout Hatchery							
Steelhead	L Campbell R	81	presmolt	14,893	May 1982	14,800	Nikomekl R.
Steelhead	Alouette R.	81	presmolt	20,090	May 1982	20,000	Alouette R.
Steelhead	Coquihalla R	81	presmolt	48,306	May 1982	48,100	Coquihalla R
Steelhead	Marshall Cr.	81	presmolt	2,721	April 1982	2,700	Marshall Cr.
Surrey Rearing Ponds							
Steelhead	L Campbell R	81	presmolt	4,029	May 1982	4,000	L Campbell R
Cutthroat	Serpentine R	81	presmolt	23,374	April 1982	23,000	Serpentine/ Nikomekl
Alouette River Correctional Center Hatchery							
Job finished, no fish at this time.							
Chilliwack Hatchery							
Steelhead		81	parr	66,600	May 1982	63,000	Chilliwack
Chum		81	alevin	4,700,000	May 1982	3,800,000	Chilliwack
Chinook	Chilliwack	81	alevin	4,400	May 1982	3,500	Chilliwack
Chinook	Harrison	81	alevin	400,000	May 1982	3,200,000	Chilliwack
Chinook	Pitt	81	fry	100,000	May/Apr 1982	80,000	Chilliwack/ Pitt
Coho		81	egg	299,000	May 1983	220,000	Dolly Varden, Post, Salwein
Coho		80	fingerling	177,000	May 1982	170,000	Dolly Varden, Post, Salwein

*includes facilities constructed prior to SEP.

Table 5 (continued)

Fraser River SEP Facilities*: Status at December 1981

				No. on	Expected Release		
Species	**Stock**	**Brood**	**Stage**	**Hand**	**Date**	**Number**	**Site**
Chehalis Band Project							
Chinook	Harrison R.	81	alevin	113,000	May 1982	79,547	Harrison R.
Chum	Harrison/ Chehalis	81	egg	730,670	April 1982	529,400	Harrison/ Chehalis
Jones Creek Spawning Channel							
Pink	Jones Cr.	81	egg	4,000,000	April 1982	1,600,000	Jones Cr.
Birkenhead Hatchery							
Chinook	Birkenhead	80	fingerling	9,787	May 1982	9,500	Birkenhead R
Chinook	Birkenhead	81	egg	69,145	May 1982	55,000	Birkenhead R
Loon Creek Hatchery							
Steelhead	Deadman/ Bonaparte	81	presmolt	39,160	April 1982	37,000	Bonaparte R.
Chinook	Bonaparte R	80	egg	60,000	May 1982	50,000	Bonaparte R.
Chinook	Nicola R.	80	egg	60,000	May 1982	50,000	Nicola R.
Quesnel Hatchery							
Chinook	Quesnel	81	egg	87,000	May 1982	70,000	Quesnel R.
Bowron Pilot Facility							
Facility abandoned; eggs incubating at Rankin Cr. facility.							
Rankin Creek (Penny) Pilot Facility							
Chinook	Bowron R	81	egg	103,800	July 1982	83,000	Bowron R.
Chinook	Slim Cr.	81	egg	102,700	July 1982	82,000	Slim Cr.

*includes facilities constructed prior to SEP.

Table 6

Fraser River SEP Facilities*: Adult Production

	Expected Production from 1981 Releases		At Full Production		
Facilities/Species	Total Adult Production	Years of Return	Total Adult Production	Year	Contribution to Fisheries
Blaney Creek Chum Facility					
Chum	4,700	1984-1985	--	--	--
Inch Creek Hatchery					
Chum	18,934	1984-1985	57,600	1987	25,033
Coho	2,375	1983-1985	4,100	1985	2,398
Cutthroat	--	--	1,830	1986	1,220
Fraser Valley Trout Hatchery					
Steelhead	4,337	1985-1987	3,800	1986	3,390
Cutthroat	--	--	5,500	1986	--
Surrey Rearing Ponds					
Steelhead	336	1985-1987	400	1986	240
Cutthroat	372	1982-1986	3,000	1986	--
Alouette River Correctional Center Hatchery					
Chum	1,428	1984-1985	21,600	1988	9,387
Coho	--	--	1,080	1986	632
Chinook	--	--	1,080	1988	884
Chilliwack Hatchery					
Chum	16,904	1984-1985	200,000	1986	86,920
Coho	--	--	150,000	1986	87,750
Chinook	--	--	15,100	1987	12,364
Steelhead	--	--	6,700	1987	4,020
Chehalis Band Project					
Coho	449	1983-1985	--	1987	--
Chum	14,560	1984-1985	131,600	1988	57,193
Chinook	1,176	1983-1987	2,160	1987	1,768

*includes facilities constructed prior to SEP.

Table 6 (continued)

Fraser River SEP Facilities*: Adult Production

	Expected Production from 1981 Releases		At Full Production		
Facilities/Species	**Total Adult Production**	**Years of Return**	**Total Adult Production**	**Year**	**Contribution to Fisheries**
Jones Creek Spawning Channel					
Pink	40,000	1983	--[1]	1983	--
Chum	750	1984-1985	1,200	1986	522
Birkenhead Hatchery					
Chinook	2,278	1983-1987	2,916	1986	2,387
Loon Creek Hatchery					
Steelhead	1,562	1985-1987	1,200	1986	4,800
Chinook	2,225	1983-1987	1,500	--	1,007
Bowron Pilot Facility					
Chinook	304	1983-1987	--[2]	--	--
Rankin Creek (Penny) Pilot Facility					
Chinook	630	1983-1987	2,880	1985	2,358

*includes facilities constructed prior to SEP.

[1] Production in even years only.
[2] Facility abandoned in 1981.

West Coast Vancouver Island

San Juan Enhancement Society

The San Juan Enhancement Society's project enhances mainly coho and chinook salmon stocks on the San Juan River near Port Renfrew. The incubation and rearing facility is located on Four Mile Creek, a tributary to Granite Creek which flows into the San Juan River.

In 1981, there was one full-time project manager and one part-time assistant, supplemented by approximately 3,200 hours of volunteer time.

All 1980 brood chinook, coho, pink and chum salmon eggs were incubated in ten 100,000-egg upwelling incubators. An additional 50,000-egg incubator was used for 1980 brood sockeye eggs. Emergent sockeye, chum and pink fry were fed for a few days prior to release in their donor streams. Chinook and coho fry were reared for approximately 90 days prior to release.

Egg-to-fry survival from 1980 brood stock varied from three percent to 100 percent at this project in 1981. Of the original 159,100 chinook eggs taken from 1980 brood stock, 5,600 fry emerged and were released in the San Juan River in mid-June. The low survival rate--three percent--was caused by a temporary loss of water supply and by silt deposition in the incubation box.

Flooding caused heavy silt deposition, resulting in low egg-to-fry survivals with coho, chum and pink salmon. Some 92,500 coho fry, or 17 percent of 538,100 eggs, were released in mid-June. From the original egg take of 15,800 chum eggs, only 4,300 (27 percent survival rate) fry emerged in April. Only 100 pink fry emerged in April from the original 2,000-egg take.

Egg-to-fry survival of sockeye was 100 percent, and the resulting 25,000 fry were released as they emerged in April.

During the fall, volunteers from Port Renfrew captured brood stock for the 1981 egg take. Coho and chinook spawners were collected in beach seines in the San Juan River and then trans-

Brood stock are captured and transported to and held in hatchery pens until maturity.

ported to and held in hatchery pens until maturity; a total of 251,300 chinook eggs and 657,860 coho eggs was collected. Sockeye salmon were captured in gillnets just before entering Fairy Lake to spawn; 62,000 sockeye eggs were collected. Chum spawners captured in Granite Creek yielded 7,000 eggs.

During 1981, the hatchery was expanded. A second water intake was constructed, which doubled the water supply. The original water intake was renovated. Self-cleaning screens and silt removal pipes were installed on both intakes to prevent future siltation problems. An egg-take/incubation building and a gravel storage shelter were also constructed.

In 1982, the two water intakes will be modified further and additional rearing space will be added to the hatchery.

Contact: Linda Thorson, Project Coordinator, Special Projects.

Gordon River Reconnaissance

At the request of the local fishery officer in Sooke, Small Projects conducted stream reconnaissance of the Gordon River and Braden Creek. Of specific interest were the sections inaccessible to native chinook and coho runs. The intent was to assess coho and chinook fry stocking potential. It was concluded that fry transplants from the Port Renfrew hatchery into these inaccessible reaches should be deferred until the lower reaches are seeded to capacity. Presently, these lower reaches provide far superior spawning and rearing habitat.

Contact: Mel Sheng, Biological Technician, Special Projects.

Public Participation Projects

Contact: Trevor Morris, SEP Community Advisor, Victoria.

South Vancouver Island Aid The Fish Society

This group, based in Sooke, constructed several small slotted fishways on Green Creek to assist the passage of returning coho salmon to upstream spawning areas. Three people were involved with this project in 1981.

Sooke Conservation Society

The Sooke Conservation Society predates SEP, starting in 1972 and being incorporated in 1976. In 1981, approximately 50 Society members continued work in the Sooke River area, concentrating on De Mamiel, Rocky and Maryvine Creeks.

The incubation site at De Mamiel Creek was expanded and redesigned in 1981. Fry from the 1980 brood were fed in pools of the creek while incubation boxes were partially filled with biorings (a gravel substitute made of plastic) and fitted with egg trays. In the spring of 1981, 110,000 coho fry were released (egg-to-fry survival was 90 percent). In addition, 37,000 chinook fry were released, representing a 53 percent egg-to-fry survival rate.

The Veitch Creek project, also under the Society's auspices, produced 1,500 coho.

The group also logged two months of intensive work to relocate the incubation facility from Maryvine Creek to Rocky Creek (off De Mamiel Creek). The task was completed in time for the return of coho brood stock to De Mamiel Creek. In the fall, the Society supplied this project with 32,000 fertilized coho eggs, which were incubated in pumped groundwater. Regular chemical treatments resulted in a 90-percent survival rate of these eggs to the early alevin stage. More than 260,000 eggs in total were incubated at the Rocky Creek location in upwelling gravel boxes, Heath trays, Atkins boxes and upwelling boxes with egg trays and bio-rings.

Nitinat hatchery supplied 40,000 chinook eggs at the eyed stage in December. The Society added a further 32,000 coho eggs to the De Mamiel Creek project. Adult coho were held until maturity in plastic tubing which was submerged in Capilano-style rearing troughs; this seemed to eliminate disease and mortality among the coho. Both chinook and coho fry will be reared before being released to local watersheds in 1982.

A member of the Sooke Conservation Society places a coho in a holding tube.

About 50 people participated in this large project during 1981.

For 1982, the Society is planning to coordinate an instream fry feeding program, to be carried out by schools, local organizations and the public in the spring and summer.

Pacific Trollers' Association--Bamfield

This was the Association's third year of a project to increase the coho population of Pachena River near Bamfield. Of the 26,000 eggs from the 1980 brood stock, 17,840 fry emerged and were released; this represents a 68 percent survival rate. In the fall, Association members were prepared to capture coho brood stock from a Pachena River tributary and incubate the eggs in their 50,000-egg upwelling gravel box. However, early high water prevented capture of the returning adult salmon.

The Association had planned to assist Eric Godson Memorial School as part of the Salmonids in the Classroom program--obtaining and fertilizing coho eggs for a classroom incubator.

Ten people were involved with this project in 1981.

Eric Godson Memorial School

The students at this Bamfield school prepared an aquarium for incubating coho eggs which were to be supplied by the Pacific Trollers' Association. However, early rains in the fall created freshet conditions throughout the Pachena River, making it extremely difficult to capture brood stock. Before the year-end, the school did obtain 2,600 eggs from one female coho.

Alberni Enhancement Society

Society members transported, fertilized and planted surplus eggs from the Robertson Creek hatchery into gravel beds in Beaver and Lanterman

Creeks in the Somass River system toward the end of the year. Seven members of the Society were involved with this project in 1981. The Society also received some help from the Port Alberni Fishermen's Association. A project to construct and operate a small hatchery at the China Creek marina proposed by the Port Alberni Harbor Commission will be included with the Alberni Enhancement Society project.

Beaver Creek Elementary School

As part of Salmonids in the Classroom, pupils obtained coho eggs from Robertson Creek hatchery and incubated them in an aquarium in the classroom. The students are gathering data and sampling the eggs, as well as studying salmonid habitat in Beaver Creek, where the resulting fry will be released in 1982.

Thornton Creek Volunteer Society

Members of this Ucluelet group installed two upwelling gravel boxes adjacent to the community development hatchery on Thornton Creek, using the hatchery's water supply. Members planted 36,500 chum eggs in one box while awaiting the return of coho brood stock in Lostshoe Creek. Permission was obtained to incubate 103,500 coho eggs from the Robertson Creek hatchery for eventual release into Sandhill Creek. Some of the coho fry may be reared after hatching.

The volunteers also put in a day's work at Robertson Creek hatchery to repair a damaged water intake. The Society has 34 members.

Ahousaht Education Committee

Through the Distance Education Program at the B.C. Institute of Technology, secondary students in Ahousaht constructed a 50,000-egg upwelling box and installed it beside Anderson Creek during the fall. Approximately 26,000 chum eggs were taken from local stocks.

Students gathered data which are being used, along with other salmonid environmental information, as part of the Salmonids in the Classroom package.

The resulting chum fry will be released in Anderson Creek in 1982.

Nitinat River Hatchery

The Nitinat River hatchery is located at the confluence of the Nitinat and Little Nitinat Rivers, approximately 60 km southwest of Port Alberni. The hatchery was designed to incubate 28 million chum salmon eggs and 1.5 million chinook eggs.

Construction of the hatchery complex was completed in 1981. This included the power generation plant, river pumping station, aeration tower, office building and crew residence.

Using 1980 brood stock, a pilot project was run; 2.3 million fed chum fry and 81,129 chinook smolts were released during the spring of 1981. Marking programs were carried out for hatchery evaluation.

Due to an above-average escapement of adult chum salmon, full egg capacity--29.5-million chum eggs--was reached in the first year of full operation. In addition, 590,000 chinook eggs were taken, of which 40,000 were transplanted to the Sooke River project. The adults, both chum and chinook, were seined from Nitinat River or Lake and held in net pens until maturity. The adults were stripped, and the eggs were then transported to the facility. Adult returns of 403,000 chum and 15,000 chinook are anticipated from this year's smolt releases.

Contact: Karl Petersen, Stock Enhancement Officer, Enhancement Operations; Roy McGechaen, Senior Project Engineer, Engineering.

Robertson Creek Hatchery

Robertson Creek hatchery, located 15 km northwest of Port Alberni, produces chinook, coho and steelhead. Total capacity of the hatchery now is nine million chinook smolts, one million coho smolts, and 250,000 steelhead smolts.

In 1981, more than 10 million juvenile salmonids were released from this facility. Approximately 9,106,000 chinook (1980 brood), with an average weight of 5.6 g, were released. For a diet study, 55,950 chinook were marked and then released; these fish averaged 4.8 g each. A total of 1,095,000 coho (1979 brood) were reared to 19.2 g in 1981. Approx-imately 73,000 steelhead, averaging 48.3 g each, were released in 1981, while 24,123 steelhead (averaging 52.7 g each) originating from wild stock were released. These releases are expected to contribute significantly to B.C. fisheries in the next few years.

The facility is also utilized for research purposes. Special studies undertaken in 1981 included: use of Japanese keeper channels for chinook, a diet study for chinook, satelliting chinook from the Nahmint River, coho egg transplants, and the timing of coho through the Barkley Sound fishery.

Six Japanese-style channels were used, at three different densities (8,000 fry/m^2, 11,500 fry/m^2, and 15,000 fry/m^2) and two flows at each density (136 L/min, 273 L/min). By the 50-percent yolk absorption stage, some crowding and suffocation of the alevins had occurred in the two higher densities. To avoid further losses of alevins, the remainder were transferred to other facilities. Few losses occurred in the channel having 8,000 fry/m^2 at 136 L/min.

In the chinook diet study, fish were fed a dry diet developed by the West Vancouver Laboratory; the diet contained lipid contents of nine or 18 per-

At the Robertson Creek facility, steelhead are initially reared in starter troughs.

cent. The quality of these diets was compared with the standard hatchery diet of Oregon Moist Pellets (OMP).

Eighteen thousand chinook eggs from the Nahmint River were incubated, and the resulting fry were reared at Robertson Creek for a satellite experiment. After being reared, the fish will be released back in the Nahmint in the spring of 1982.

Coho eggs were transplanted for a few public participation projects--143,000 to the Port Alberni Enhancement Society (resulting fry will be released in three tributaries of the Stamp River), and 3,000 to the Beaver Creek school project.

To study the timing of coho through the Barkley Sound fishery, crews tagged early-, mid-, and late-run fish. The study will help determine the feasibility of enhancing early-run coho to reduce or eliminate problems with mixed stock (steelhead and wild chinook) fisheries.

There were several modifications to the facility in 1981. The existing incubation building was extended to accommodate additional Heath trays for steelhead. Each stack of trays is supplied with a separate aerated surface and well water supply. Eighteen Capilano-style troughs were installed for intermediate steelhead rearing. Each trough has a separate aerated surface and well water supply.

The expansion hatchery site (initiated in 1980) was partially landscaped, with the balance to be completed in 1982.

Contact: Don Lawseth, Stock Enhancement Officer, Enhancement Operations; Otto Rapp, Senior Project Engineer, Engineering.

Somass Steelhead

Summer steelhead returning to native streams in Alberni Inlet are severely impacted by the expanding commercial fishery for enhanced sockeye returning to Great Central Lake. A major program designed to mitigate the losses caused by commercial interception, is underway; Robertson Creek hatchery facilities are being utilized.

Information regarding steelhead stock sizes and run timing is being used to select brood stock that will subsequently produce adults which migrate through commercial fishing areas after peak fishing periods.

In 1981, the program focussed on:
- brood stock collection and egg take
- adult steelhead transplants
- release of 1980 brood steelhead smolts.

Three hundred late summer/fall run adults were selected for brood stock from more than 1,500 steelhead returning to the Robertson Creek facility. An additional 25 winter steelhead adults (caught by angling) were transported from the lower Stamp and Somass Rivers to Robertson Creek hatchery. These fish generally pass through commercial fishing areas after the peak fishery.

During the spring of 1981, 74 mature steelhead were relocated from Robertson Creek hatchery to the upper Ash River. An additional 322 adults were released to the same area in October, 1981. These fish (excess to hatchery needs) were tagged and released upstream of the old Dickson Lake logjam, a barrier the Fish and Wildlife Branch removed in 1979. Fifteen percent of the steelhead released in October returned to Robertson Creek hatchery, a distance of approximately 16 km.

Some 100,000 smolts from the 1980 brood (late summer/fall adults) were released in April 1981; 2,000-3,000 adults are expected to return.

In the spring of 1981, 269,441 and 48,055 eggs were taken from late summer/fall and winter steelhead adults, respectively. Approximately 175,000 and 25,000 smolts of summer/fall and winter origin, respectively, will be released in the spring of 1982.

The 1982 program will be similar to that of 1981, except that Nahmint River summer steelhead adults returning early may be collected in an attempt to reestablish an early run of summer steelhead in the Somass system.

The successful hatchery program will permit a year-round consumptive fishery for hatchery-produced adults, beginning in 1982.

Contact: Bob Hooton, Fisheries
Biologist, Fish and Wildlife
Branch, Nanaimo.

Thornton Creek Hatchery

The Thornton Creek hatchery is located at the mouth of Thornton Creek in Ucluelet Inlet, on the west coast of Vancouver Island. The hatchery was established in 1976 to enhance the chum and possibly coho and chinook salmon stocks for the commercial, sport and Indian food fisheries.

Originally built and operated by SEP staff, this hatchery now is operated by the Thornton Creek Enhancement Society, under contract to SEP. The Society consists of local commercial fishermen and Indian bands. The project employs a full-time hatchery manager and a part-time assistant. In 1981, an additional 20 weeks of unpaid time was donated to the project by hatchery staff and Society members.

In 1981, totals of 1,266,300 and 235,900 chum eggs were collected from brood stock in Thornton and Salmon Creeks, respectively. The chum eggs were incubated in Atkins boxes, and then transferred to keeper channels. Survival to the eyed stage was 89 percent. Chum fry will be released in April, 1982.

Thornton Creek hatchery staff strip a chum salmon of its eggs.

A crew enumerated chum spawners in Thornton, Mercantile and Salmon Creeks, and counted the number of marked adult chum at the local fish processing plants.

SEP engineers installed a concrete rearing pond and a modified water intake at the facility. An adult fence was also installed, but the fence will have to be modified in 1982 to withstand heavy flood conditions.

In 1982, a hydro line and a fish collection fence will be installed. The facility may also incorporate coho and chinook incubation and rearing. A stream reconnaissance program will be undertaken during the summer.

Contact: Linda Thorson, Project
Coordinator, Special
Projects.

Tlupana Inlet/Conuma Hatchery

The Tlupana Inlet project now is in its fourth year of development. The central hatchery is located on the Conuma River, 42 kilometres west of Gold River. Five streams located on the Tlupana Inlet contribute chum brood stock to the Conuma hatchery, where the eggs are incubated to the hatched stage, and the fry are reared to one-gram size. The fry are then transported to their parent streams (either by truck or by helicopter), and imprinted and released.

Japanese-style hatchery methods were used at this project in 1981, and production increased to eight million chum fry. With the exception of Deserted Creek, survival rates of fry released in all streams improved, compared to the previous year. Recurring problems with high mortalities of eggs from Deserted Creek brood stock prompted the Fisheries Research Branch to study possible causes. Preliminary findings indicate that the losses occurred mainly with eggs from females held in salt water; there was a 41-percent mortality rate among eggs from sea-pen spawners, compared to 11 percent from fresh water spawners.

A helicopter was again used during the spring to transport both Tlupana and Deserted Creek chum fry from the central hatchery to their parent streams for imprinting prior to release. A smooth operation has been perfected to transport these fish--by using a fish pump to load two fire-fighting "monsoon" buckets, crews airlifted approximately 2.3 million one-gram fish over a three-day period.

For the first time, male and female coho were airlifted from the Conuma River to concrete holding ponds at the hatchery. The fish were stripped, and approximately 100,000 eggs were subsequently fertilized.

Adult chinook returns during the fall included two-year-old males from 1979 brood stock. These hatchery fish appeared to stay mainly in the river with the wild stock and did not try to enter the hatchery.

Almost 15 million chum eggs were collected in the fall of 1981. In the fall of 1982, the full capacity of 23 million chum eggs may be reached.

Contact: Iain MacLean, Stock
Enhancement Officer,
Enhancement Operations;
Otto Rapp, Senior Project
Engineer, Engineering.

Public Participation Projects

Contact: Bob Hurst, SEP Community
Advisor, Nanaimo.

Gold River Rod and Gun Club
Members of this group salvaged coho fry from Heber Creek during low flow periods of the summer and released them into the Gold River.

Quatsino School
Quatsino School students conducted a stream survey on an unnamed stream in order to locate an appropriate site for an incubation facility. However, the project was postponed because of a conflict over logging plans for the valley through which the stream runs.

Holberg School and Canadian Forces Base
Twenty adults and schoolchildren combined efforts during the spring and released approximately 2,500 coho fry from their facility into Goodspeed River in Holberg. Although the lack of brood stock resulted in few eggs, the egg-to-fry survival was greater than 95 percent.

In the fall, 6,000 coho eggs from Goodspeed River brood stock were taken.

West Coast Vancouver Island Reconnaissance

Bio-engineering reconnaissance surveys were conducted in September on the west coast of Vancouver Island to identify enhancement potentials. The surveys were conducted by helicopter in Areas 23-27. The various physical and biological characteristics that were examined consisted of: salmon population size, spawning distributions, spawning ground quality and quantity, potential gravity water supplies, obstructions, and spawning and rearing potentials above obstructions. Consideration was also given to assessing groundwater potential on the basis of surface outflows and the physical characteristics of the watershed.

Due to adverse weather conditions, some rivers in the Tofino and Kyuquot areas were not covered. Several opportunities were identified on the Kennedy, Burman, Tahsis systems and on many more tributaries of the West Coast inlets.

Additional reconnaissance is required in upcoming seasons to confirm the opportunities identified and to cover the areas missed last year.

Contact: Bruce Shepherd, A/New
Projects Coordinator,
Enhancement Operations;
Jim Wild, Senior
Implementation Engineer,
Engineering.

Table 7

West Coast Vancouver Island SEP Facilities*: Juvenile Releases 1981

Species	Brood	Group	Total Released	% Marked	% Survival	Avg. Size(g)
San Juan Community Development Project						
Pink			100	N/A	5[1]	N/A
Chum			4,300	N/A	27[1]	N/A
Sockeye			25,000	N/A	100	N/A
Coho			92,500	N/A	17[1]	2 - 4
Chinook	1980	San Juan R.	5,600	N/A	3	6.0
Nitinat Hatchery						
Chinook	1980	Nitinat	90,129	87	93	5.1
Chum	1980	Nitinat	2,311,624	7	92	1.0
Robertson Creek Hatchery						
Chinook	1980	production	9,106,000	1.7	86.3	5.62
Chinook	1980	diet study	55,950	100	79.0	4.79
Coho	1979	production	1,095,822	5	63.0	19.19
Steelhead	1980	hatchery stock	72,995	98	73.5	48.34
Steelhead	1980	wild stock	24,123	97	79.6	52.70
Thornton Creek Hatchery						
Chum			325,000	N/A	N/A	N/A
Tlupana Inlet Development						
Chinook	1980	Conuma R.	198,000	50	88	3.0
Chum	1980	Conuma R.	3,468,646	0.2	93.0	1.6
Chum	1980	Sucwoa R.	2,874,000	7.2	79.6	1.1
Chum	1980	Deserted R.	1,953,000	5.7	41.9	1.2
Chum	1980	Canton Cr.	318,500	0	86.2	1.6
Chum	1980	Tlupana R.	328,000	27	75.6	2.1

*includes facilities constructed prior to SEP.

[1] Low survival due to flooding.

[2] Low survival due to temporary loss of water supply and silt deposition in the boxes.

Table 8
West Coast Vancouver Island SEP Facilities: Status at December 1981*

Species	Stock	Brood	Stage	No. on Hand	Date	Expected Release Number	Site
San Juan Community Development Project							
Coho		81	egg	608,000	June 1982	507,415	San Juan R.
Chinook		81	alevin	251,130	June 1982	186,932	San Juan R.
Chum		81	egg	7,100	April 1982	7,100	Granite Cr.
Sockeye		81	egg	62,000			
Nitinat Hatchery							
Chum		81	egg	521,000	June 1982	375,000	Nitinat R.
Chinook		81	egg	27,400,000	Apr. 1982	20,000,000	Nitinat R.
Robertson Creek Facility							
Chinook	Robertson	81	egg	9,673,000	June 1982	8,000,000	Robertson Cr
Chinook	Nahmint	81	egg	18,000	June 1982	14,000	Nahmint
Coho	Robertson	80	fingerling	1217,000	May 1982	1,200,000	Robertson Cr
Coho	Robertson	81	egg	1,508,000	May 1983	1,000,000	Robertson Cr
Steelhead	Robertson	81	fingerling	200,000	May 1982	180,000	Robertson Cr
Steelhead	Somass	81	fingerling	26,700	May 1982	24,000	Robertson Cr
Thornton Creek Hatchery							
Chum	Thornton/ Salmon Cr.	81	egg	1,502,200	April 1982	1,276,870	Thornton Cr.
Tlupana Inlet Development							
Chinook	Conuma	81	alevin	168,000	May 1982	140,000	Conuma R.
Coho	Conuma	81	alevin	108,000	Aug. 1982	90,000	Conuma R.
Chum	Conuma	81	alevin, eggs	4,416,900	April 1982	3,500,000	Conuma R.
Chum	Sucwoa	81	alevin	4,372,000	April 1982	3,500,000	Sucwoa R.
Chum	Deserted	81	alevin	3,750,000	April 1982	3,000,000	Deserted R.
Chum	Canton Cr.	81	alevin	544,000	April 1982	435,000	Canton Cr.
Chum	Tlupana	81	alevin	457,000	April 1982	365,000	Tlupana R.

*includes facilities constructed prior to SEP.

Table 9
West Coast Vancouver Island SEP Facilities*: Adult Production

Facilities/Species	Expected Production from 1981 Releases		At Full Production		
	Total Adult Production	Years of Return	Total Adult Production	Year	Contribution to Fisheries
San Juan Community Development Project					
Pink	3	1983	--	--	--
Chum	34	1984-1985	630	--	277
Sockeye	420	1985-1986	335	--	--
Coho	1,110	1983-1985	12,960	--	4,536
Chinook	168	1983-1987	--	--	--
Nitinat Hatchery					
Chinook	2,434	1983-1987	32,400	1989	17,366
Chum	46,232	1984-1985	403,200	1989	177,408
Robertson Creek Hatchery					
Chinook	103,073	1983-1987	270,000	1987	216,000
Coho	164,250	1983-1985	150,000	1985	83,300
Steelhead	2,900	1985-1987	10,000	1987	3,750
Thornton Creek Hatchery					
Chum	5,200	1984-1985	28,800	1987	12,672
Coho	--	--	1,620	1985	695
Chinook	--	--	3,240	1987	1,737
Tlupana Inlet Development					
Chum	178,843	1984-1985	331,200	1989	145,728
Chinook	2,227	1983-1987	43,200	1991	19,699

*includes facilities constructed prior to SEP.

East Coast Vancouver Island

Colquitz Creek Habitat Improvement

Since there was insufficient data to judge the number of juvenile salmonids attributable to small stream enhancement projects, an evaluation program was initiated in 1977 to collect these data. The project focussed on the effects of habitat on the salmonid population in Colquitz Creek, which flows into the western arm of the Victoria Harbor/Gorge Waterway system.

The Fish Habitat Improvement Section was primarily involved throughout the project's inception, habitat development, experimental assessment, data analyses, and reporting. The study culminated in the preparation of a report, which will be available in 1982.

The success of the project means better understanding of fish production in small streams, better appreciation of habitat and flow needs of coho and cutthroat, better understanding of benefit values and smolt yield in existing (good) habitat compared to enhanced habitat, and increased wild smolt yield.

In-stream boulder placement appears to be a practical fish habitat enhancement technique, especially as public involvement projects. Large benefits can be derived by releasing, at prescribed rates, unfed fry into habitat known to be vacant to yield significant numbers of coho and cutthroat.

Contact: Ron Ptolemy, Fisheries
Biologist, Fish Habitat
Improvement Section, Fish and
Wildlife Branch, Victoria.

Vancouver Island Sea-run Cutthroat Trout

Enhancement programs during 1981 involving sea-run cutthroat have ranged from small incubation-and-fry-release projects to the release of hatchery-reared smolts. During the 1981 season, emphasis was placed upon the need for a better understanding of the biological and recreational implications obtained from stocking anadromous cutthroat trout smolts. The primary objective of the cutthroat smolt stocking program is to provide the urban centers of the east coast of the Island with a local fishing area for trout in tidewater.

In the spring, data on the survival of hatchery smolts after release were collected at a downstream trapping facility on Colquitz Creek. From a total of 20,000 smolts released into this small urban stream, approximately 75 percent survived the downstream migration to the Gorge waterway.

During the summer and fall, the catch of sea-run cutthroat in the Gorge/Inner Harbor area was monitored by means of an intensive creel survey. Cutthroat, known for their ability to feed and grow within the confines of bays or estuaries, made a surprisingly successful return debut to the urban fishery. During the four-month random sampling period, a total of 983 anglers were contacted. An estimated total effort of 6,690 hours of fishing resulted in a catch of 1,729 cutthroat trout, of which 96 percent were of hatchery origin.

Fish released in the spring at an average length and weight of 195 mm and 80 grams, respectively, returned to the fishery in October at an average size of 332 mm and 385 grams.

The effects on the cutthroat trout beach fishery, in the Miracle Beach/ Oyster River area, also proved successful, with the second year's release of pen-reared cutthroat smolts. A total of 15,210 cutthroat smolts were released in May in Oyster River and Black Creek. Snorkel surveys of the Oyster River, initiated to monitor the return of cutthroat trout during the fall migration period, indicated that there were significant increases over the previous year's escapement. At the peak of the upstream migration, more than 400 hatchery origin cutthroat were identified, along with a good return of 200 wild adults. These escapements into tributary watersheds to Oyster River and Black Creek will help reseed previously-underutilized juvenile habitat.

In 1982, the hatchery stocking and analysis will continue assisting in future management of cutthroat trout for Vancouver Island; a summary report of stocking anadromous cutthroat trout will also be completed.

Contact: Pete Law, Fisheries
Biologist, Fish and Wildlife
Branch, Nanaimo.

Cutthroat and Steelhead Enhancement

Adult cutthroat were collected in traps or by angling in Colquitz Creek, Sandhill Creek, Black Creek, and the Oyster River. In 1981, three sites were used for rearing juvenile cutthroat and steelhead; another site was used for incubating steelhead eggs and rearing the resulting fry.

Migrating adult sea-run cutthroat were collected at traps located on Black Creek, Colquitz Creek and Sandhill Creek; angling and seining methods were used on the Oyster River. The Black Creek Recreation Association assisted in the operation of the Black Creek fence.

After capture, cutthroat were held until mature at the Black Creek rearing ponds, as well as at a site in the Greater Victoria Water District, where Goldstream River water was used. Adult steelhead from the Englishman and Tsitika Rivers were held to maturity at the Nanoose facility. Poor water conditions at a temporary holding site on the Cowichan River resulted in 40 percent mortality of Cowichan River steelhead. All cutthroat eggs have been incubated at Fraser Valley trout hatchery and the resulting fry are being reared for one year in off-site rearing facilities on Vancouver Island.

In late 1981, negotiations were undertaken with the District of North Cowichan to lease property and water for a Vancouver Island hatchery. This facility, slated for completion in mid-1982, would be used to hold adult fish, incubate eggs, and rear fry of Vancouver Island steelhead stocks, with most fry being planted in six streams during their first year of life. This hatchery would also be used to hold maturing adult cutthroat and Cowichan steelhead with the resultant progeny moved to net pens for additional off-site rearing to smolts.

Sites at Black Creek and Saanich are used to rear cutthroat in net pens placed in earthen ponds supplied with water from springs or wells. With the cooperation of the B.C. Forest Service and Pacific Logging, a large net pen is operated for steelhead and cutthroat at Cowichan Lake; the trout will be reared and then released as smolts in the Cowichan River. During the first two years of operations, high river water temperatures in July and August have caused high fish mortalities. This problem should be partially alleviated with completion of the Vancouver Island hatchery, where young steelhead could be held until water temperatures moderate before being transferred to Cowichan Lake.

Net-pen culture of cutthroat and steelhead appears to be a means of producing quality smolts at reasonable cost. However, rearing densities (8g/L) must be lower than what is common in conventional hatcheries. Also, water temperatures must be relatively warm in winter, and tempertures must only exceed 18°C for short periods in summer.

All cutthroat eggs are treated with erythromycin phosphate and Wescodyne to reduce the risk of introducing disease organisms into the culture facility. Smolts are vaccinated against vibrio disease several months prior to their release as smolts in April and May.

Contact: Hugh Sparrow, Fish Culture Biologist, Fish and Wildlife Branch, Victoria.

Public Participation Projects

Contact: Trevor Morris, SEP Community Advisor, Victoria

Wilkinson Road Community Correctional Center

Under the supervision of local field staff, inmates of this Center in Victoria cleared debris and improved fish habitat on Goldstream River and Colquitz and Craigflower Creeks.

Marler Conservation Society

The Society took on the project of feeding coho fry isolated in pools of Craigflower Creek during the summer months. The fry, isolated due to low water levels, were fed twice daily until water levels returned to normal in the fall. About four people were involved in this project over the summer.

Amalgamated Conservation Society

The Society continued with its work with the incubation box, spawning channels and fry feeding on Goldstream River. Society members repaired winter flood damage to the river and constructed a fry-rearing channel adjacent to the incubation site. Also, the Society incubated up to 50,000 chinook and 50,000 coho eggs and reared the resulting fry before release.

In the fall and winter, the Society enhanced the stream area and constructed adult salmon trapping facilities. The group was able to capture returning coho spawners and gather 57,000 eggs, which were incubated in an upwelling gravel box.

This volunteer project is 11 years old, predating SEP. In 1981, 100 volunteers were involved.

Mill Bay and District Conservation Society

Society members continued with their incubation program for coho and modified difficult passages by placing small fishways on Shawnigan Creek.

In 1981, the Society released 6,000 fry from 1980 brook stock.

Prior to the return of coho brood stock near the end of the year, Society members had reconstructed the site and water supply, prepared gravel and incubation trays, and constructed capture facilities. However, high water and poor stock returns contributed to a minimal egg take--4,100 eggs from Shawnigan Creek stock and a further 6,700 eggs from Goldstream River spawners.

Approximately 30 people were involved in this project in 1981.

Shawnigan Lake School

As a Salmonids in the Classroom

project, three grade nine classes, working independently of each other, obtained 10,500 salmon eggs each from chum brood stock in Goldstream River. The 31,500 eggs were incubated on tap water while the students monitored the equipment, studied development and tabulated data. The resulting fry will be released into Goldstream River in 1982.

Discovery Elementary School
Goldstream River chum salmon were captured, and 14,000 eggs were taken and transported to the school. Students placed the eggs in 182-litre aquariums. One aquarium was designed to operate on tap water, while the other used recirculated creek water. Both were filled with egg trays and partially filled with gravel substrate. The students discovered that when the eggs in tap water were in the advanced alevin stage, the other eggs were only at the eyed stage.

The students will gather data and sample the eggs during incubation and release the resulting fry into Goldstream River.

Katimavik
Seven students in the Katimavik program assisted in the operation of the community development hatchery at Cowichan during the peak of egg-take activities, monitored the migration of coho brood stock in many streams in the Duncan area, and located and identified habitat conditions affecting migration.

Yount Elementary School
The pupils removed gravel build-up from the lower reaches of Coonskin Creek, which flows into Cowichan Lake, east of Youbou.

After the rehabilitation project was completed, the pupils constructed and installed a 20,000-egg upwelling box beside the creek. Members of the Valley Rod and Gun Club and school staff attempted to capture coho brood stock in Robertson and Mesachie Creeks in the fall, but many of the fish had already spawned; only 1,400 eggs were taken.

The pupils monitored the water flow and temperature as part of the Salmonids in the Classroom course.

The pupils are making plans to rehabilitate Coonskin Creek to provide rearing areas for the coho fry.

Ladysmith Sportsmen's Club
Club members had planned to capture coho salmon at Bush Creek and incubate 50,000 eggs in a streamside incubation box at Rocky Creek. However, the Club was unable to develop the chosen incubation site before the brood stock returned, and high water conditions added further complications. The Club has developed plans for the 1982-1983 operation. Approximately 37 people were involved in this project in 1981.

Cowichan Band Project

The Cowichan Band operates a hatchery on the Cowichan River, near Duncan, on Vancouver Island. In 1981, the Band incubated eggs, reared and coded-wire tagged fry from 1980 brood Cowichan River chum and chinook salmon; made major modifications to the water distribution system, including a new well and aeration tower; expanded the incubation facilities; reared coho fry salvaged during 1980 and 1981; and collected 1981 Cowichan chum and chinook for brood stock purposes.

SEP funding provided the project with a crew ranging from four to 11 persons. Additional staff were funded by the Canada Employment and Immigration Center.

In 1982, this facility will shift its emphasis from chum production to chinook and coho production. With this change in emphasis on target species, the beneficiaries are expected to be saltwater anglers in the Gulf of

Georgia and Cowichan Bay and freshwater anglers in Cowichan and Koksilah Rivers.

Contact: Chris de Hrussoczy-Wirth, Project Coordinator, Special Projects.

Chemainus River

The groundwater-fed Westholme channel of the Chemainus River was extended upstream to provide an additional 950 square metres of chum salmon spawning area.

Contact: Rheal Finnigan, Senior Engineer, Special Projects.

Nanaimo Community Development Project

This project was set up to enhance the chum, coho, chinook and steelhead stocks in the Nanaimo River watershed and to bring the natural runs of these salmonids to optimum production levels. The project employs seven people full-time and five part-time. In addition, project staff, local fishermen and fish and game club members volunteered much time and effort.

Brood stock is checked for ripeness at the Nanaimo Community Development Project.

In 1981, the project utilized a variety of incubation techniques--Heath trays, upwelling incubators, Atkins boxes, and fibreglass troughs.

Chinook fry were reared for approximately 90 days prior to release in the lower Nanaimo River. Coho fry were reared for up to three months and released in underutilized rearing areas in the upper Nanaimo watershed. The majority of the chinook and coho were coded-wire tagged and released at a size of five grams and four grams, respectively. Chum fry were reared to one gram and then released in the lower Nanaimo River. Steelhead were reared to two grams and released in underutilized parts of the watershed.

Egg-to-fry survival rates of all species from 1980 brood stock were high--all above 75 percent. From the original egg take (in 1980) of 27,000 spring-run and 222,000 fall-run chinook eggs, 21,338 and 179,500 fry, repectively, emerged and were released in May. This is an egg-to-smolt survival rate of 79 percent and 81 percent, respectively. In the fall, 37,400 eggs were collected from the spring run of brood stock, and a further 20,960 eggs were collected from the fall run.

In mid-June, 95,400 coho fry were released in the upper Nanaimo watershed. These fry, which emerged from the original 110,200 eggs taken from 1980 brood stock, represent an egg-to-fry survival of 87 percent. In the fall, some 161,190 eggs were collected from 1981 brood stock.

Of the original 1980 egg take of 1,112,000 chum eggs, 901,000 fry emerged and were released (a survival rate of 82 percent) in 1981. In the fall, 1,146,700 eggs were collected from 1981 brood stock.

Egg-to-fry survivals for trout were also high. Of the original 45,000 eggs taken from 1981 steelhead brood stock, 37,400 fry emerged and were released; this represents a survival rate of 83 percent. In the fall, 5,140 eggs were collected from 1981 cutthroat brood stock. Survival to the fry stage was 87 percent; these fry will be reared to the smolt stage and released in 1982.

Generally, egg take targets set for chinook and coho were not met: extremely high flood conditions hampered attempts to capture fall chinook and coho brood stock, and poor runs of adult chinook during the spring and autumn created further difficulty. On the other hand, the capture of chum brood stock was very successful.

Local anglers who participated in the catch-and-release fishery on the Nanaimo River helped to capture steelhead brood stock. Electrofishing was used to help capture cutthroat brood stock.

Biweekly snorkel surveys were undertaken from March to June to determine the timing, distribution and relative abundance of returning adult steelhead and spring-run adult chinook. Surveys were again conducted in the fall to collect data on returning adult fall-run chinook, chum and coho.

The biophysical survey and inventory were completed in 1981, detailing habitat according to the specifications of the provincial Resource Analysis Branch. To determine stocking sites for juvenile steelhead and coho and sea-run cutthroat, electrofishing was carried out.

The hatchery was expanded in 1981 to include a warehouse, workshop and enlarged residence. Incubation capacity was increased by adding four Atkins boxes, and rearing capacity and diversity were increased with the addition of two rearing ponds, four circular ponds and eight aluminum troughs.

In 1982, the cement rearing ponds will be completed, and final modifications will be made to the hatchery layout. In addition, plans are being drawn up for a fish collection fence on Haslam Creek.

Contact: Linda Thorson, Project Coordinator, Special Projects.

Public Participation Projects

Contact: Bob Hurst, SEP Community Advisor, Nanaimo.

Departure Bay Creek Elementary School

Early in 1981, the students carried out a preliminary stream survey to determine possible areas for enhancement. They proposed:

- spawning platforms in the lower part of the creek
- low dams to hold back water for juvenile rearing during low summer flows
- a 25,000-egg facility for coho, if a suitable site can be found.

Unfortunately, there was insufficient time before the school's summer break to carry out any of the work, but in the fall, the students, under the guidance of the RCMP, began a "stream watch" surveillance program, reporting any activity that might harm fish.

Malaspina College/Nanaimo Fish & Game Protection Association

Four college students and Association members completed a biophysical survey of the Millstone River system near Nanaimo.

In September, 50,000 coho fry from the Nanaimo River hatchery were released into the Millstone River.

The College plans to construct a mini-hatchery for coho and cutthroat trout on the Millstone River; it will become part of the College's fish culture training program.

French Creek Sport Boat Owners' Association

The Association continued with its efforts to restore coho to historic levels in Craig Creek, Parksville. A rearing pond spanning approximately 0.8 ha (two acres) was created in the upper watershed, resulting in a significant increase in the carrying capacity of the system. Forty thousand coho fry from the Qualicum hatchery were released into the flooded area. Small sandbag dams were built in suitable areas of the stream to provide rearing pools during the summer's low-flow periods. Remedial work was done on an elevated culvert which had prevented fish access to habitat upstream.

Through the group's voluntary efforts since 1979, Craig Creek now has the potential to support a coho fishery equal to that of traditional levels. Although the stream remained in excellent condition throughout the fall and winter, there was no recorded escapement into the system this past season. To offset this, an additional 5,000 coho fry from the Qualicum hatchery were released into the system in October.

About eight people were involved in this project in 1981.

Qualicum Beach Recreation Society

The Society, consisting of 25 members, concentrated its time and efforts on Beach Creek, which flows through Qualicum Beach into the Georgia Strait. A recent graduate of the Malaspina College fish culture course used sandbags to construct a series of rearing areas for the low-flow periods. The College has agreed to incorporate enhancement work of this stream into its training program.

The Society also released into the creek 20,000 Qualicum hatchery coho fry and 20,000 fry from an incubation facility on the system.

During the summer, Parksville Middle School took over the Beach Creek project.

The incubator was cleaned and repaired in the fall to prepare for the 20,000 coho eggs to be introduced in January, 1982.

Parksville-Qualicum Fish and Game Association

The Association made an application, which was approved, to place a 200,000-egg incubation facility on Crown land at French Creek. Plans for a water supply were completed, and the land was cleared. Efforts were also made to secure wetlands in the upper watershed to be used for rearing fry and to help moderate low flows during the summer months.

About 30 people were involved in this project.

Maple Guard Ratepayers' Association

Six Association members created rearing ponds and spawning platforms in Deep Bay Creek, which flows into Deep Bay, northwest of Bowser. Some 4,000 (7-gm) coho fry were released into the stream in October. The small stream now is partially protected by the establishment of parkland in the upper section.

Cumberland Chamber of Commerce

The Cumberland Chamber of Commerce constructed a 200,000-egg incubation facility on Roy Creek in Cumberland during the summer. The group, involving ten people, also constructed a concrete dam with a fishway, and spawning platforms. The dam will store water for release during periods of low flow. The spawning platforms were used by eight adults for natural spawning in the fall of 1981.

In the winter, 20,000 coho eggs were taken from Puntledge hatchery for the incubation facility.

Brooklyn Creek Salmonid Project

Under the direction of Mr. J. Stubbs, this group of about four people created rearing habitat for coho in the lower section of Brooklyn Creek in Comox. Escapement into the system has been declining, and the work of this group should result in an improved fry-to-smolt survival.

Courtenay District Fish and Wildlife Protective Association

The Association has been enhancing coho and cutthroat stocks at its incubation facility in Courtenay during the past year. From 100,000 Puntledge hatchery coho eggs incubated, 75,000 fry emerged in 1981. The fry were fed for three weeks before being released in the upper watershed of the Trent River, located seven kilometres south of Courtenay.

Eggs from eight cutthroat from the Oyster, Puntledge and Little River systems yielded approximately 7,500 fry. Association members fed the fry for four weeks before releasing them in the appropriate streams. The male cutthroat brood stock were treated with malachite green (to control fungus infection) and released into their native streams.

Later in the year, the 20 Association members upgraded the water supply and also obtained 100,000 coho eggs from Puntledge hatchery for incubation.

Pacific Trollers' Association

In 1981, approximately 15 Association members were involved in this project. They put in a diversion dam on Kitty Coleman Creek, in the Courtenay area, to control flow to a side channel, and they constructed a 100,000-egg incubator on the side channel, in autumn, in preparation for the 20,000 eyed coho eggs to be supplied by Puntledge hatchery in January, 1982.

April Point Flyfishing Club

Approximately ten Club members worked continuously through the year on an incubation project in Drew Harbor Creek on Quadra Island. In the spring, approximately 30,000 chum fry emerged from 40,000 eggs incubated. Although the fry were fed while they remained in the incubator, no attempt was made to hold them. An additional 25,000 coho fry from the Quinsam hatchery were released into the upper watershed.

During the summer, Club members improved the incubator in preparation for chum eggs in October. The 40,000 eyed chum eggs were taken from Hyacinthe Creek brood stock, incubated to the eyed stage at the Hyacinthe Creek hatchery, and then transferred to the Drew Harbor Creek facility, where they completed incubation.

Granite Bay Conservation Association

Four Association members focussed its attention on enhancing pink, coho and chum stocks in the Granite Bay Creek system on Quadra Island. Approximately 60,000 pink fry emerged, in the spring of 1981, from the 100,000 eggs supplied by Quinsam hatchery the previous year. Most of the mortality occurred during the early stage of development because of fungal problems caused by unseasonally high water temperatures.

Some 25,000 coho fry from the Quinsam hatchery were released into the upper watershed.

General maintenance of the incubation facility was carried out during the summer. In the fall and winter, there were 100,000 pink salmon eggs and 2,500 chum eggs (1981 brood) incubating at this facility.

Quadra Island Salmonid Enhancement Society

Early in the year, the Society completed construction of a building which houses an incubation facility for coho. Much of the remainder of the year was devoted to building a dam and installing holding tanks, Heath trays and upwelling boxes. The hatchery has a capacity for 750,000 eggs.

In the spring, Society members released 60,000 coho fry from the Quinsam hatchery into a watershed on Quadra Island.

By the end of the year, the incubation facility had 16 Heath trays, an Atkins box, plus two upwelling boxes (new design). Forty thousand chum eggs were taken and developed to the eyed stage for the Drew Harbor Creek facility operated by the April Point Flyfishing Club, and 200,000 coho eggs were incubated during the winter.

About 20 people were involved in this project.

Pacific Trollers' Association--Sayward
The Association's incubation facility is located on a side channel of the Memekay River, a tributary of the Salmon River (near Sayward). Members released approximately 7,500 coho fry into the system in the spring. Egg-to-fry survival was greater than 95 percent, even though the entire facility was covered with more than one metre of water during winter flooding.

During the summer and fall, the Association expanded its facility to a capacity of 500,000 eggs, from the previous 100,000-egg capacity. A large holding pen for adult salmon was also installed, and a steel broomstick trap was constructed.

At year-end, there were 78,000 chinook eggs and 250,000 coho eggs incubating at this facility. Survival to the eyed stage is more than 95 percent.

About 15 people were involved in this project during 1981.

Top Island Econauts Society
This group compiled a report describing the general river ecology and fish populations of the Tsitika River prior to logging activities in the river valley. They had carried out their field investigations in 1980.

Steelhead Society of B.C.--North Island
In the spring, eight Society members released approximately 30,000 pink salmon fry into Glenlion Creek, which is near Port Hardy. The eggs (35,000) were taken from the 1980 brood Quatse River stock.

Menzies Bay Gulf Trollers Association
The Association assisted in the release of 25,000 coho fry from the Quinsam hatchery into the upper watershed of Menzies Creek.

Haig-Brown Society
This Campbell River society has elected to establish a cutthroat trout incubation facility on Haig-Brown property. Engineering plans were designed for the diversion of Kingfisher Creek and for a water supply for the trout facility. The Society is now negotiating with the municipal government and provincial Ministry of Transportation and Highways to secure an acceptable plan to proceed.

Nimpkish Rod and Gun Club
The Club's 50,000-egg incubation box for coho was not operational in 1981 due to a lack of brood stock.

Western Forest Products--Port McNeill
Approximately eight Western Forest Products employees volunteered their time during the summer and completed construction of four concrete incubation tanks plus attached collection tanks, and a concrete holding tank for a 200,000-egg incubation facility on Marble River. The water supply for the facility is taken from the Utah Mines' pump house on the Marble River.

Although the incubation facility was ready for use by the end of the year, there were many problems in capturing brood stock; therefore, only 3,500 chinook eggs and 500 coho eggs were incubating at the end of the year.

Western Forest Products' employees also constructed a 50,000-egg incubation box on Nequiltpaalis Creek, also in Port McNeill. At the end of the year, 40,000 chum eggs were being incubated there.

Redcliff Creek Project

During the summer, this group attempted to have part of the watershed of Redcliff Creek designated as an ecological reserve and to locate a dam site to create a water supply for coho rearing. Redcliff Creek is near Port Hardy.

Little Qualicum Spawning Channel

This facility is located on the Little Qualicum River, 2 km north of Qualicum Beach. It includes an artificial spawning channel for chum salmon and a rearing channel for juvenile chinook and steelhead trout.

The spawning channel, which is 4.16 km long and 7.5 m wide, can accommodate 50,000 spawners and produce an estimated 59 million fry annually. Since the project began in 1979, chum salmon escapements to the river have been poor. As a result, with an abundance of spawning area in the river, the fish opt for the river, rather than the channel, to spawn. Therefore, channel counts are also low. Despite the low escapements (4,000 to 7,000 per year) to the channel, egg-to-fry survival rates have been excellent--over 75 percent per year. It was hoped that the channel would reach full production by 1984; however, it now appears that it may take an additional two years to reach this goal.

The rearing channel has a capacity for 1.5 million chinook smolts and 25,000 steelhead smolts. With all fish for the rearing program being supplied from the Big Qualicum hatchery, it has been possible to operate at full production since it opened in 1980. A good number of chinook jacks returned during the fall of 1981 and the first steelhead returns began to show up in December 1981, indicating a promising future for chinook and steelhead at Little Qualicum. Most adults from the first year of operation will return during the winter of 1982.

In 1981, approximately 1.5 million chum fry from the channel were fed, for three or four weeks prior to release, in an attempt to increase adult production. The rearing program went very well and will probably be expanded in 1982. However, a chum egg-take operation that was planned for November-December 1981 was hampered by high water in the river; as a result, less than 200,000 eggs were taken.

The Little Qualicum project is somewhat unique in that its operations are being carried out under contract to a private company, Underwood McLellan Ltd.

Contact: Grant Ladouceur, Stock Enhancement Officer, Dave Barrett, Unit Head, Vancouver Island, Enhancement Operations.

Big Qualicum Project

The Big Qualicum River project is located approximately 60 km north of Nanaimo. It was built in 1965 to increase production of native stocks of chum salmon through environmental control. In the first stage of the project, facilities were constructed to allow year-round regulation of river discharge and the potential for water temperature control during the summer and fall. The second phase, carried out from 1964 to 1967, involved construction of two artificial spawning channels. The latest stage in development is the hatchery program, which began in 1968.

The Big Qualicum project contributes approximately 150,000 chum, 100,000 coho, and 90,000 chinook annually to the sport and commercial fisheries.

Flow control has more than doubled the egg-to-fry survivals for chum salmon stocks because production is not limited by the available rearing area in the river.

The first spawning channel was originally built to accommodate a pink salmon introduction program and was later used as a chum and chinook salmon spawning channel. Design problems, however, resulted in poor egg-to-fry survivals, so the channel was modified to rear hatchery chinook and coho. The second spawning channel, designed specifically for chum salmon, has been extremely successful. This channel accommodates 25,000 spawners, producing up to 27,000,000 fry annually at an estimated 75 percent egg-to-fry survival rate.

The hatchery program at Big Qualicum began as an experimental installation, testing various techniques for future hatcheries in other locations. After 1971, the hatchery became much more production-oriented, and it has expanded to become one of the largest production facilities in B.C. Present incubation capacity is 14 million eggs, and the rearing capacity is one million coho smolts, three million chinook coho smolts, three million chinook smolts, and 25,000 steelhead smolts. More than five million coho and chinook eggs are sold each year to privately-owned fish farms; some eggs are used for research, and others go to public involvement projects. Also, two million chinook and 500,000 coho fry are used to recolonize seven local streams. Steelhead smolts are produced for release into Big Qualicum and other east coast Vancouver Island streams, including Little Qualicum, Englishman, Chase, and Millstone.

The Big Qualicum project is currently operating at the capacity of existing facilities. It contributes approximately 150,000 chum, 100,000 coho, and 90,000 chinook to the sport and commercial fisheries, as well as more than 50,000 fish to the Indian food fishery, annually. The value of this annual catch is estimated to be more than $8.5 million.

Special Activities

A study was carried out during the spring of 1981 to determine the impact of bird predation, particularly that by Bonaparte's gulls, on juvenile coho and chinook salmon in the Big Qualicum estuary. Results indicate that 10 - 12 percent of the total chinook release is taken by fish-eating birds in normal production years, and up to 25 percent can be taken during years when fish are of below normal quality (as was the case in 1981, when many fish suffered from impaired vision caused by poor diets). Coho losses are considerably lower, with an average predation rate of two to four percent. The study pro-

The Big Qualicum project was initiated to increase production of native stocks of chum.

duced a number of recommendations to reduce bird predation on juveniles, some of which will be incorporated in future releases.

A pilot rearing program began this year to increase the size of chum fry prior to release. It is hoped that these fed fry will have a better chance of survival than the natural production does. The pilot will be continued for the next few years. If successful, the pilot will be expanded to a larger scale.

Contact: Grant Ladouceur, Stock
Enhancement Officer,
Enhancement Operations.

Big Qualicum Steelhead

Hatchery rearing of steelhead trout was initiated in 1972 at this project on the Big Qualicum River, 55 km north of Nanaimo. An evaluation program, to monitor the sport fishery and life history of both wild and hatchery steelhead stocks, was initiated in 1975.

The 1981 program included:

- completion of 1980-81 voluntary creel card census
- preparation of a three-year summary report (in progress)
- analysis of coded-wire tags from hatchery steelhead
- preparation and age interpretation of wild and hatchery steelhead scales
- release of the 1980 brood steelhead smolts
- selection and spawning of wild and hatchery steelhead from Big Qualicum stock for 1981 brood requirements.

Analysis of creel cards voluntarily filled out by anglers during the 1980-81 steelhead season indicated that 203 anglers fished a total of 804 hours to catch 50 wild steelhead and 87 hatchery steelhead. The total estimated run for 1980-81 was 288 hatchery and 166 wild steelhead.

During spring 1981, more than 70,000 1980 brood smolts were released to Big Qualicum, Chase, Millstone (Big Qualicum stock) and Englishman Rivers (Englishman stock). Also, 80 wild and hatchery female steelhead (Big Qualicum stock) were spawned for Big Qualicum, Chase, Millstone, Rosewall and Little Qualicum production and/or research projects.

In September 1981, the 27,000 wild and 14,000 hatchery fry that were surplus to production goals were released to the upper Little Qualicum River and Cameron Lake. Approximately 100,000 fry are presently being reared for release of 20,000 smolts to each of Big Qualicum, Little Qualicum and Chase/Millstone Rivers. Progeny of 16 wild Englishman River steelhead are also being reared at Big Qualicum hatchery. In September, 1981, 8,000 fry, surplus to the production goal of 20,000 smolts, were released to the upper Englishman River.

The 1982 program will focus on production. (No creel survey will be undertaken during the 1981-82 season.) The primary objectives for 1982 are to:

- release the 1981 brood steelhead smolts
- capture adult steelhead for 1982 production goals.

Contact: Bob Hooton, Fisheries
Biologist, Fish and Wildlife
Branch, Nanaimo.

Puntledge Hatchery

The Puntledge River hatchery is located two kilometres from Courtenay on Vancouver Island. The hatchery complex consists of three sites: a main site, at which all incubation takes place; an upper site, which is located nine kilometres upstream from the main site; and a satellite facility on the Tsolum River. Summer chinook, coho, and steelhead are reared at the upper site, while fall chinook, pink and chum salmon are reared at the main site. The Tsolum River facility is used to trap and hold pink salmon adults and to rear juvenile pink salmon.

Although the main hatchery site has been operational since 1979, the hatchery complex was officially opened in May, 1981. Full production will be reached in 1989.

Coho Colonization

In November, 1981, 203,000 coho pre-smolts (almost 50 percent of these fish were coded-wire tagged) were transplanted into the upper watershed of the Puntledge River--Cruickshank River, and upper Puntledge, Willemar and Forbush Lakes. Before B.C. Hydro placed dams on the river at Comox Lake and two kilometres downstream, wild coho, chinook and steelhead utilized these areas.

This experiment will determine if the smolts can make their way past the B.C. Hydro penstock and turbine during their migration, as well as determine the survival rate of coho fry in Comox Lake and its tributaries.

Fall Chinook

Approximately 25 percent of the chinook released in June, 1981 (from

Technicians capture brood stock for Puntledge hatchery operations.

1980 brood fall chinook) were affected by a cataract condition. Until the adults return in four or five years, the effect of this eye problem on their survival cannot be measured.

Pink Salmon Rearing

In 1981, three saltwater pens were installed in Comox Bay for experimental rearing of pink salmon. The results were successful: fry grew from 0.2 grams to 1.2 grams in 30-35 days. On the other hand, rearing the fish in fresh water was not as successful, as the fish did not feed or grow. Some 11 percent of the Tsolum pink salmon were marked with a half dorsal fin clip. The results of both these experiments will be available in 1982 and 1983, when the adults return.

Contact: Harry Genoe, Stock Enhancement Officer, Enhancement Operations; Jim Wild, Senior Project Engineer, Engineering.

Quinsam Hatchery

The Quinsam River hatchery is located less than 5 km west of the Campbell River townsite. Operational since 1974, it is currently at full production. A pink salmon offsite rearing program was conducted in the Campbell River estuary during 1981, and this program will be continued in 1982.

All chinook returning to the Quinsam River are of hatchery origin, from eggs of Campbell River stock. In 1981, 500 chinook, averaging 10-20 kg each, spawned naturally in the Quinsam River. (Another 439 were used in the hatchery for brood stock.) This "natural" run of chinook, an important side benefit of hatchery production, has remained constant for the third consecutive year.

In 1981, 2,025 chinook returned to the Campbell and Quinsam Rivers. The Quinsam River also saw the return of 26,500 adult coho.

Several special studies were undertaken at Quinsam hatchery in 1981, including:

a) Coho colonization

Of the 200,000 fry released upstream in the fall of 1980, 20 percent migrated during the spring of 1981. Approximately 52 percent of these smolts were marked to evaluate survival and contribution to the fisheries.

In the fall of 1981, 259,700 reared fry (10.3 g) were transported and released in the upper Quinsam River. A helicopter was again used to transport the fish, which were stocked at a density of 14,900 per kilometre.

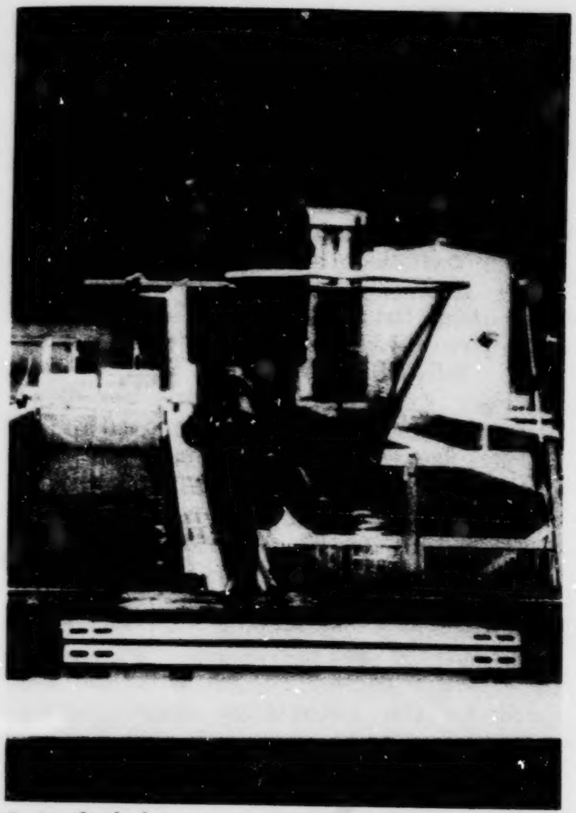
b) Diet Studies

An ongoing program of dry feed diet evaluation has been carried out since 1975. Commencing with 1976 brood coho, a dry diet formulated by the West Vancouver Laboratory has also been tested.

Preliminary results indicate that the survival rates appear to be very similar, but the fish require more dry food than moist to reach the same size. (Length of feeding time, however, is not longer). It is more difficult to start fry on dry food, nor do they respond as aggressively (in their eating patterns) to dry food.

c) Time of and size at release studies -- coho

Three groups of coho smolts, marked according to size (small, medium, and large), were released at four time intervals in the spring of 1981 to determine the best time and optimum size to release coho from Quinsam hatchery. This completes the size-and-time rearing portion of this study. Collection and assessment of data will continue throughout 1982. This information, combined with that gained from the diet experiments, will be used to increase coho survival and contribution to the sport and commercial fisheries.



A technician at Quinsam hatchery checks on brood stock, which are held until maturity.

Preliminary results indicate that a delayed release of two weeks (from the natural migration date of May 15) and a decreased target size by five g (from 25 g to 20 g) result in maximum adult returns.

d) Pink enhancement

Some 5.7 million pink salmon eggs were incubated in Heath trays. The resulting alevins were planted into gravel boxes. Upon emergence in 1982, approximately 250,000 fry will be transported to the estuary and reared in pens. Two million fry will be transported to the Bear River, and the remainder will be released directly into the Quinsam River.

e) Steelhead colonization

See next section, "Quinsam Steelhead."

As for maintenance at the hatchery, no major modifications or repairs were carried out in 1981. Modifications of a minor nature consisted of installation of four new gravel boxes with the capacity to handle seven million pink salmon alevins.

A monorail and hoist for lifting fish out of the anaesthetic tank were designed, bought and installed.

Contact: Jim Van Tine, Stock Enhancement Officer, Enhancement Operations; George Nielsen, Senior Engineer, Engineering.

Quinsam Steelhead

Steelhead smolts were first released from Quinsam River hatchery in spring, 1976. Hatchery adults began returning in 1978. In order to assess the impact of hatchery returns on the sport fishery, the Fish and Wildlife Branch undertook an intensive program to document angler effort and catch before and after the return of hatchery steelhead. Other features of the program included investigating ocean life history of wild versus hatchery steelhead, assessment of hatchery steelhead spawning distribution, assessment of the heritability of run timing, determination of wild steelhead smolt survival and the evaluation of headwater stocking of steelhead fry.

The 1981 program included:

- completion of 1980-81 creel survey (April) and preparation of a draft report summarizing six years of creel data
- analysis of CWTs from hatchery steelhead collected during the creel survey
- preparation and age interpretation of wild and hatchery steelhead scales
- interpretation of adult steelhead tagging information (final report in preparation)
- selection and spawning of wild

steelhead brood stock (18,900 smolts presently on hand)

- release of 20,457 steelhead smolts (1980 brood) to Quinsam River
- release of 28,300 Quinsam River origin steelhead fry (1981 brood) to Quinsam River headwaters
- release of 15,100 Salmon River origin steelhead fry to headwater areas of the Salmon River.

There was a wild steelhead catch-and-release regulation in effect from December 15, 1980 to February 28, 1981. Hatchery steelhead comprised 31 percent of the estimated Campbell/Quinsam catch.

During the 1980-1981 season, anglers fished an estimated 6,800 hours on the Campbell River, keeping 53 steelhead and releasing 294 fish. Quinsam River anglers fished an estimated 4,100 hours, keeping 26 steelhead and releasing 162 fish. CWT recovery data revealed that angler-recovered steelhead were mainly of 1977 brood origin. Smolt-to-adult survival of the 1977 brood was approximately 1.9 percent.

No further creel surveys are planned for this system.

Contact: Bob Hooton, Fisheries Biologist, Fish and Wildlife Branch, Nanaimo.

Bear River Hatchery

The Bear River (Amor de Cosmos Creek) hatchery is located northeast of Campbell River on the Bear River, which exits from McCreight (Bear) Lake and flows into Johnstone Strait on the east coast of Vancouver Island.

The original installation was built by the Fisheries Research Branch as an experimental project to test theories on introduction of odd-year pink salmon.

In 1980, this station was turned over to SEP for production operation.

A production target of five million pink salmon eggs was set for 1980, to be taken from not more than one-third of the total escapement. Incubation boxes were installed with a capacity for approximately seven million eggs.

In the fall of 1980, 2.2 million eggs were collected. In the spring of 1981, 260,000 fry were reared and released from sea pens in the Bear River estuary. The balance of 1.5 million fry were released directly from the hatchery to the river.

Plans are being formulated to introduce two million pink fry from the Quinsam River to establish an odd-year escapement.

In 1981, packed column aeration was added to the incubation water supply system.

The center section of the counting fence was undermined and had to be removed in 1981. This center section will have to be replaced for operation in 1982.

Contact: Jim Van Tine, Stock Enhancement Officer, Enhancement Operations; Alan Boreham, Project Engineer, Engineering.

Vancouver Island Summer Steelhead

Preservation and enhancement of summer steelhead stocks is a high priority on Vancouver Island. Five years of snorkel surveys and 12 years of steelhead catch data reveal sharp declines in virtually all historically productive streams. On the east coast of Vancouver Island, significant wild summer steelhead populations now exist only in the White and Tsitika Rivers, north of

Campbell River.

Regulations governing summer steelhead fisheries have now been substantially modified to ensure that remaining stocks are completely protected. Sensitive holding areas have been closed to angling, and "no-kill" angling regulations have been implemented throughout the Region. Several important spawning and rearing areas have also been closed to angling.

In 1978, SEP sponsored a study to determine the feasibility of enhancing the impoverished east coast summer steelhead fishery. Tsitika brood stock was captured and transported to the Fish and Wildlife Branch hatchery at Abbotsford for holding and spawning. Four of five females were successfully held for five months and spawned; subsequently, approximately 25,000 unfed fry were transported back to the Tsitika River in 1979.

The program was expanded in 1979 and 1980 to explore the potential for utilizing Tsitika stock and lake pen rearing facilities to implement a smolt release program. Several lakes were surveyed, and all major east coast drainages were assessed for their capacity to support summer steelhead fisheries. Approval was received to rear smolts at the Fish and Wildlife Branch's O'Connor Lake pen facility in the Keogh drainage. The stream assessment program revealed that the Campbell system furnished the best opportunity for a summer fishery. The Transplant Committee has approved the transplanting of some Tsitika steelhead into the Campbell River.

As an adjunct to the smolt program, all Vancouver Island watersheds from Victoria to Sayward and the Gold River system were examined for capacity to produce steelhead smolts from plants of fry in inaccessible reaches. A rating system was developed, and a list of projects resulted.

The 1981 program included:

- snorkel surveys of White, Gold, Heber, and Tsitika Rivers to document population size and response to protective regulations
- rearing of approximately 13,000 presmolt 1981 brood Tsitika steelhead at O'Connor Lake
- capture and transport of 19 female and eight male Tsitika summer steelhead to holding facilities located at Nanoose
- assessment of the efficacy of colonizing barren habitat within the Gold River drainage with native summer steelhead fry
- seining, transport and release of 61 surplus Heber River summer steelhead adults to reaches upstream of the migration barrier.

Summer steelhead populations in indicator streams appear to have responded to restrictive angling regulations imposed in 1976. This trend will be carefully monitored in future. Gold River tributaries offer excellent potential for smolt production from presently barren reaches; a decision on whether to utilize summer or winter steelhead brood stock for this purpose is forthcoming.

Contact: Bob Hooton, Fisheries
Biologist, Fish and Wildlife
Branch, Nanaimo.

Nimpkish Hatchery

The Nimpkish Band operates a hatchery on Willow Creek, at the south end of Nimpkish Lake, through a contract with SEP. An average of six people were employed throughout the year, and the band had a successful year in terms of fish production and staff training and development.

More than 2.5 million sockeye fry from the 1980 brood year were released into Nimpkish Lake in April of 1981. Approximately 177,000 chum (1980 brood) were released into the Nimpkish River after being reared in net-pens for two weeks.

Through the summer months, a variety of construction activities were undertaken to upgrade the hatchery facility. These included installing new Atkins boxes, Pallant boxes, rearing troughs, and associated plumbing.

In the fall of 1981, 1.7 million eggs were collected from sockeye in a tributary of the Nimpkish River and transported to the Willow Creek hatchery. Chum salmon were seined near the Nimpkish estuary and held to mature, allowing the collection of a half-million eggs. These eggs are currently being incubated at the hatchery. Chinook salmon eggs were not collected this year due to the difficulty in locating and holding adult fish. More emphasis will be directed toward enhancing chinook salmon in 1982.

Contact: Colin Masson, Project
Coordinator, Special
Projects.

Johnstone Strait Reconnaissance

A number of biological and engineering reconnaissance surveys were conducted by helicopter between February and September in Johnstone Strait to identify enhancement opportunities. Various physical and biological characteristics were examined, including: salmon population size, spawning distributions, spawning ground quality and quantity, potential gravity water supplies, obstructions, and spawning and rearing potentials above obstructions. Consideration was also given to assessing groundwater potential on the basis of surface outflows and the physical characteristics of the watershed.

All major river systems in Areas 11-15 were covered. The mainland inlets appear to have relatively more opportunities than the other areas covered by reconnaissance this year.

Additional work is required in the upcoming seasons to confirm the opportunities identified, and in some cases, to proceed with further feasibility work.

Contact: Bruce Shepherd, A/New
Projects Coordinator,
Enhancement Operations;
Jim Wild, Senior
Implementation Engineer,
Engineering.

Table 10

East Coast Vancouver Island SEP Facilities*: Juvenile Releases 1981

Species	Brood	Group	Total Released	% Marked	% Survival	Avg. Size(g)
Cowichan Community Development Project						
Chum			630,000	8.8	84	N/A
Chinook			90,000	59.1	70	N/A
Cowichan Hatchery						
Steelhead	1980	Cowichan River	9,385	100	26	61.3
Cutthroat and Steelhead Enhancement						
Cutthroat	1980	Sandhill Cr.	4,748	100	N/A[1]	103.1 - 108.7
Cutthroat	1980	Fulford Cr.	2,800	100	N/A	89.3
Cutthroat	1980	Colquitz Cr.	5,598	100	61	73.5
Cutthroat	1980	Fulford Cr.	14,459[2]	100	N/A	84.7
Cutthroat	1980	Oyster R.	8,061	100	N/A	40.5 - 54.6
Cutthroat	1980	Oyster R.	2,015[3]	100	N/A	18.8
Cutthroat	1980	Black Cr.	7,151	100	80	29.6 - 73.5
Cutthroat	1981	Colquitz Cr.	3,000	100	N/A[4]	1.2
Cutthroat	1981	Sandhill Cr.	16,700[5]	0	N/A	2.2
Cutthroat	1981	Oyster R.	700	0	N/A	1.6
Cutthroat	1981	Black Cr.	5,900	0	N/A	1.8
Chemainus Hatchery						
Chinook			107,000	N/A	N/A	N/A
Nanaimo Community Development Project						
Chum	1980		901,000	N/A	82	N/A
Steelhead	1981		37,400	N/A	85	N/A
Chinook	1980	spring run	21,338	94.8	79	5.0
Chinook	1980	fall run	179,500	40.6	81	5.0
Coho	1980		95,400	66.5	87	4.0
Little Qualicum Spawning Channel						
Chum	1980		7,627,000	N/A	N/A	N/A
Chinook			1,178,000	N/A	N/A	N/A
Steelhead			10,876	N/A	N/A	N/A

*includes facilities constructed prior to SEP.

Table 10 (continued)

East Coast Vancouver Island SEP Facilities*: Juvenile Releases 1981

Species	Brood	Group	Total Released	% Marked	% Survival	Avg. Size(g)
Big Qualicum Project						
Steelhead	1980	Big Qualicum, wild	21,982	100	71	33.55
Steelhead	1980	Chase & Millstone	25,038	0	88	32.85
Steelhead	1980	Englishman R.	24,365	100	81	36.23
Coho	1979	Big Qualicum	697,409	10	31	17.52
Chinook	1980	Big Qualicum	4,335,402	3	86	6.59
Chum	1980	Big Qualicum	61,805,918	N/A	N/A	N/A
Puntledge Hatchery						
Coho	1979	production	719,711	9.0	59.0	21.1
Coho	1980	colonization	203,154	49.6	76.0	14.29
Chinook	1980	summer/production	690,234	14.0	85.0	5.9
Chinook	1980	fall/production	389,418	26.7	88.0	4.8
Chum	1980	production	3,327,834	3.1	94.4	1.2
Pink	1980	Puntledge R.	631,651	0	60.9	0.52
Pink	1980	Tsolum R.	884,296	11.5	74.6	0.51
Steelhead	1980	summer/production	18,322	98.5	70.0	37.3
Steelhead	1980	fall/production	15,243	91.8	39.1	42.4
Quinsam Hatchery						
Chinook	1980	production	381,729	13.42	73.17	6.82
Chinook	1980	production	411,885	12.84	73.17	7.28
Chinook	1980	production	343,164	17.88	73.17	7.74
Coho	1979	production	375,198	13.3	68.71	24.4
Coho	1979	disease evaluation	56,249	33.19	65.63	21.71
Coho	1979	diet study	66,040	29.22	69.25	21.84
Coho	1979	diet study	66,266	27.85	69.22	24.26
Coho	1979	diet study	76,469	24.52	72.19	24.7
Coho	1979	diet study	73,975	26.26	71.52	21.76
Coho	1979	size & time	271,560	49.95	70.68	25.11
Coho	1980	colonization	296,635	34	57	10.32
Coho	1980	Hurst Cr.	148,220	N/A	57	3.0

*includes facilities constructed prior to SEP.

Table 10 (continued)

East Coast Vancouver Island SEP Facilities*: Juvenile Releases 1981

Species	Brood	Group	Total Released	% Marked	% Survival	Avg. Size(g)
Quinsam Hatchery, Cont'd						
Steelhead	1980	Quinsam early run	6,310	100	30.6[6]	54.76
Steelhead	1980	Quinsam late run	14,237	100	74.35	54.76
Steelhead	1981	Quinsam colonization	28,334	100	52	9.00
Steelhead	1981	Salmon R.	15,000	0	87.76	4.30
Pink	1980	sea pen	259,850	25.7	94.57	1.07
Pink	1980	production	1,812,217	5.53	94.57	0.21
Bear River Hatchery						
Pink	1980	sea pen	260,807	29.18	82.83	0.76
Pink	1980	production	1,554,604	6.47	82.83	0.18
Nimpkish Hatchery						
Sockeye	1980	Nimpkish R.	1,500,000+		77	
Chum	1980	Nimpkish R.	940,000		77	

*includes facilities constructed prior to SEP.

Footnotes

[1] Survival not applicable, since additional fish were released in 1980.
[2] Released into Colquitz Cr.
[3] Released into Little Oyster River.
[4] Released at Royal Roads.
[5] Survival not applicable, since additional fish of this brood are on hand.
[6] Low survival is a result of high mortality immediately after ponding; cause unknown, but under investigation.

Table 11
East Coast Vancouver Island SEP Facilities: Status at December 1981*

Species	Stock	Brood	Stage	No. on Hand	Expected Release Date	Expected Release Number	Expected Release Site
Cowichan Hatchery							
Coho	Cowichan R.	80	fry	4,400	April 1982	4,300	Cowichan R.
Chinook	Cowichan R.	81	alevin	231,000	May 1982	32,300	Cowichan R.
Chum	Cowichan R.	81	egg	1,200,000	May 1982	690,000	Cowichan R.
Cutthroat and Steelhead Enhancement							
Cutthroat	Sandhill Cr	81	presmolt	5,200	April 1981	5,000	Sandhill Cr.
Cutthroat	Colquitz Cr	81	presmolt	18,124	April 1981	18,000	Colquitz Cr.
Cutthroat	Sandhill Cr	81	presmolt	3,568	April 1981	3,500	Colquitz Cr.
Cutthroat	Black Cr.	81	presmolt	6,036	April 1981	6,000	Black Cr.
Cutthroat	Oyster R.	81	presmolt	3,483	April 1981	3,450	Oyster R.
Cutthroat	Sandhill Cr	81	presmolt	4,000	April 1981	3,900	Cowichan R.
Steelhead	Cowichan R.	81	presmolt	11,307	May 1981	11,000	Cowichan R.
Chemainus Hatchery							
Chinook		81	egg	15,800	June 1982	13,000	Chemainus
Coho		81	egg	17,800	June 1982	14,000	Chemainus
Nanaimo Community Development Project							
Coho	Nanaimo R.	81	egg	161,186	May 1982	50,100	Nanaimo R.
Coho		81	egg		Aug. 1982	66,000	Nanaimo R.
Chinook	Nanaimo R.	81	fry	18,233	July 1982	14,350	Nanaimo R.
Pink	Nanaimo R.	81	alevin	3,334	April 1982	2,560	Nanaimo R.
Cutthroat	Nanaimo R.	81	fry	2,290	May 1982	2,188	Nanaimo R.
Chum	Nanaimo R.	81	egg	1,146,700	April 1982	888,000	Nanaimo R.
Little Qualicum Spawning Channel							
Chum		81	egg	6,000,000	May 1982	4,200,000	L. Qualicum

Table 11 (continued)

East Coast Vancouver Island SEP Facilities*: Status at December 1981

Species	Stock	Brood	Stage	No. on Hand	Expected Release Date	Expected Release Number	Expected Release Site
Big Qualicum Project							
Coho		80	fingerling	1830,000	May 1982	1,600,000	B. Qualicum
Chum	hatchery	81	egg	3,000,000	May 1982	2,200,000	B. Qualicum
Chum	channel/ river	81	egg	120,000,000	May 1982	50,000,000	B. Qualicum
Coho		81	egg	3,000,000	May 1982	500,000	local creeks
Coho		81	egg		May 1983	1,000,000	B. Qualicum
Chinook		81	egg	5,800,000	June 1982	3,000,000	B. Qualicum
Chinook					June 1982	1,500,000	L. Qualicum
Steelhead		81	parr	102,400	April 1982	80,000	BQ, LQ, Englishman, Millstone
Puntledge Hatchery							
Chinook	summer	81	alevin	434,000	June 1982	347,000	Puntledge R.
Chinook	fall	81	alevin	136,000	June 1982	109,000	Puntledge R.
Coho	Puntledge	81	egg	4,532,000	May 1983	1,000,000	Puntledge R.
Coho					June 1982	3,000,000	Comox L.
Coho	Puntledge	80	fingerling	1001,000	May 1982	1,000,000	Puntledge R.
Pink	Puntledge	81	egg	983,000	March 1982	786,000	Puntledge R.
Pink	Tsolum	81	egg	908,000	March 1982	726,000	Tsolum R.
Chum	Puntledge	81	egg	2,494,000	April 1982	1,995,000	Puntledge R.
Steelhead	summer	81	parr	34,000	May 1982	33,000	Puntledge R.
Steelhead	winter	81	parr	40,000	May 1982	39,000	Puntledge R.
Quinsam Hatchery							
Chinook	Quinsam	81	egg	1,256,000	May 1982	900,000	Quinsam R.
Coho	Quinsam	80	fingerling	1330,000	May 1982	1,275,000	Quinsam R.
Coho	Quinsam	81	egg	1,711,000	Sept. 1982	300,000	U. Quinsam R
					May 1983	1,000,000	Quinsam R.
Pink	Quinsam	81	egg	5,715,000	April 1982	3,500,000	Quinsam R.
					April 1982	2,000,000	Bear R.
Steelhead	Quinsam	81	parr	19,500	May 1982	19,000	Quinsam
Chum	Quinsam	81	egg	88,000	May 1982	70,000	Quinsam

Bear River Hatchery

No pink escapement in odd years; no eggs incubating.

Species	Stock	Brood	Stage	No. on Hand	Expected Release Date	Expected Release Number	Expected Release Site
Nimpkish Hatchery							
Sockeye	Nimpkish	81	egg	1,700,000	May 1982	1,389,000	Willow Cr.
Chum	Nimpkish	81	egg	499,000	June 1982	230,000	Willow Cr.

*includes facilities constructed prior to SEP.

Table 12

East Coast Vancouver Island SEP Facilities: Adult Production*

	Expected Production from 1981 Releases		At Full Production		
Facilities/Species	**Total Adult Production**	**Years of Return**	**Total Adult Production**	**Year**	**Contribution to Fisheries**
Puntledge Hatchery					
Coho	112,020	1983-1985	126,000	1988	70,230
Chinook	32,390	1983-1987	151,000	1994	106,268
Chum	66,557	1984-1985	120,000	1986	52,800
Pink	37,898	1983	20,000	1983	6,000
Steelhead	1,007	1985-1987	2,756	1987	1,378
Quinsam Hatchery					
Chinook	34,103	1983-1987	30,000	1985	21,112
Coho	214,085	1983-1985	369,000	1985	205,673
Steelhead	701	1985-1987	1,000	1985	500
Pink	110,203	1983	160,000	1984	48,000
Bear River Hatchery					
Pink	50,385	1983	130,000[1]	1983	58,200
Nimpkish Hatchery					
Sockeye	19,800	1985-1986	68,600	1988	38,416
Chum	18,800	1984-1985	10,800	1986	4,968
Chinook	--	--	2,160	1991	1,469

*includes facilities constructed prior to SEP.

[1] Production in even years only.

Table 12 (continued)

East Coast Vancouver Island SEP Facilities*: Adult Production

Facilities/Species	Expected Production from 1981 Releases: Total Adult Production	Expected Production from 1981 Releases: Years of Return	At Full Production: Total Adult Production	At Full Production: Year	At Full Production: Contribution to Fisheries
Cowichan Hatchery					
Chum	12,600	1984-1985	56,300	1988	24,772
Chinook	2,700	1983-1987	10,800	1987	7,600
Coho	375	1983-1985	1,080	1985	602
Steelhead		1985-1987	2,000	--	1,000
Cutthroat and Steelhead Enhancement					
Cutthroat	6,061	1982-1986	3,500	1986	--
Steelhead	376	1985-1987	--	--	--
Chemainus Hatchery					
Chinook	3,210	1983-1987	3,000	1986	2,111
Nanaimo Community Development Project					
Chum	5,911	1984-1985	12,910	1987	5,680
Steelhead	668	1985-1987	410	1986	205
Chinook	6,010	1983-1987	6,440	1986	4,532
Coho	1,145	1983-1985	3,240	1986	1,806
Cutthroat	--	--	2,240	1987	-
Little Qualicum Spawning Channel					
Chum	58,139	1984-1985	360,000	1989	158,400
Chinook	13,253	1983-1987	40,000	1986	28,149
Steelhead	326	1985-1987	735	1985	367
Big Qualicum Project					
Steelhead	2,141	1985-1987	6,500	1987	3,280
Coho	139,482	1983-1985	212,000	1985	131,440
Chinook	130,062	1983-1987	90,000	1986	63,335
Chum	403,800	1984-1985	349,000	1988	153,560

*includes facilities constructed prior to SEP.

Central Coast

Bella Bella Hatchery

The Bella Bella Band, under contract to SEP, operates a chum hatchery at McLoughlin Bay near Waglisla, on Campbell Island. The project employs five full-time staff and attempts to increase chum salmon for the commercial fishery on the central coast.

Of the 350,000 chum eggs taken in 1980, 190,000 fry emerged in 1981 and were reared for six weeks before release. In the fall of 1981, the hatchery crew collected 1,013,870 chum eggs from spawners in a donor stream approximately 13 kilometres from the hatchery site. The eggs were incubated first in Atkins boxes and then transferred to upwelling Pallant boxes.

With the acquisition of additional Atkins and Pallant boxes, the hatchery's incubation capacity was increased in 1981 to accommodate up to 1.4 million eggs. Freshwater-rearing capacity was increased to 200,000 emerging fry with the addition of Capilano-style rearing troughs. Sea pens were constructed to accommodate up to one million one-gram-sized fry, which are reared in salt water for up to six weeks after emergence from the gravel.

A weekly monitoring program was continued at Deer Pass (approximately 24 kilometres from the village of Bella Bella) for assessing the physical characteristics of the watershed for the proposed development of a second hatchery. Construction has begun on a moorage float and a boardwalk as preliminary steps toward development.

During 1981, hatchery staff completed fish culture courses at Malaspina College in Nanaimo. A total of 29 individuals were involved on the project during the year, including students, temporary workers and those hired as part of a social assistance program.

In 1982, the Band hopes to construct a flow control weir at the outlet of McLoughlin Bay Creek. The weir will increase the freshwater-rearing capacity of the hatchery and enable the rearing of coho.

Egg-take targets will increase to 1.5 million (from 1.3 million) chum eggs. In addition, 50,000 coho eggs will be taken, and the fry will be reared until they reach five grams each.

Other new work planned for 1982 includes: the rehabilitation of McLoughlin Bay Creek; downstream enumeration, trapping and tagging of 1981 chum brood stock prior to release in April, 1982; and the construction of a storage/maintenance building. In addition, further development at Deer Pass is expected.

Contact: Maurice Boisvert, Project
Coordinator, Special
Projects, Community
Development Unit.

Public Participation Projects

Contact: Barry Peters, SEP Community Advisor, Terrace.

Kitasoo Community School/Kitasoo Band

The objective of this project is to introduce students to the life cycle of salmon and to its environmental needs. Kitasoo Band members and the students constructed an incubation box to enhance the chum stocks in Klemtu Creek. A total of 11,000 chum eggs were incubated and hatched in a small tank in the classroom. Approximately 2,000 fry were released into Klemtu Creek.

The project was greeted with interest and enthusiasm by the entire village. In 1982, the students hope to expand the project into a larger outdoor incubation system.

Hartley Bay School

Students from this school, located near Douglas Channel, have operated an incubation box on Hartley Creek since 1978.

In 1981, approximately 20 students were active in the project. A concrete incubation box was built and approximately 10,000 coho eggs were incubated; 6,000 fry were released in May.

In the fall, about 7,500 coho eggs were taken.

Bella Coola Hatchery

The Bella Coola chum hatchery is located 15 km east of Bella Coola, on Snootli Creek. The full capacity of the Japanese-style hatchery is 10 million eggs or 7.2 million reared fry. Although the facility was completed in 1979, full production is not expected until 1986.

Eggs from the donor stock of four streams--Snootli, Fish, and Nuhalk Creeks and the Salloomt River--were incubated separately and the resulting fry were reared separately. The reared fry were released to their natal streams at the peak of wild fry migration. Fry from the Salloomt River and Fish Creek were fin clipped; in 1984 and 1985, the years the fish return as adults, the spawning grounds will be surveyed for marked fish. The number of marked fish returning will help determine fry-to-adult survival rates and the amount of straying from one tributary to another. In addition, half of the Fish Creek fry received a double fin-clip, so that the rate of fin regeneration can be monitored.

In a diet experiment, Oregon Moist Pellet (OMP) fish food was compared to a semi-moist food (Biodiet). The experiment was discontinued after several weeks because the semi-moist diet contained an unacceptable amount of "fines." There was concern that these fines would cause gill damage and subsequent fish-health problems.

In 1981, two new wells with an approximate combined capacity of 3,400 L/min. were drilled to supplement the existing groundwater supply and sustain full capacity at the Snootli Creek hatchery.

Contact: Russ Hilland, Stock Enhancement Officer, Enhancement Operations; Ken Jones, Engineering Technician, Otto Rapp, Senior Project Engineer, Engineering.

Bella Coola Steelhead Stocking

The Bella Coola River historically supported one of British Columbia's most popular steelhead sport fisheries. However in recent years, steelhead stocks in this river have declined, and angler harvests have therefore been restricted accordingly.

Habitat degradation and overharvesting by the sport and Indian food fisheries are the major causes of this decline.

This project was undertaken to increase the smolt output and thereby restore angling activity to former levels.

In 1981, the first fry release of a five-year stocking program was undertaken on the Salloomt River, a tributary to the Bella Coola. The objective of the project is to establish steelhead in previously-unused rearing habitat above a set of impassable falls. The barriers will eventually be removed, thus allowing the population to become self-perpetuating.

Brood stock was obtained from the Atnarko River, primarily through the operation of a weir on a small side channel. Incubation and rearing were undertaken at the federal Snootli Creek hatchery. A total of 98,070 eggs were taken, from which 78,790 fry (averaging 0.7 g each) were subsequently produced. These fry were released into the headwaters of the Salloomt. Approximately 7,100 fry were retained at the hatchery, to be reared to smolt-size.

As part of this program, the survival and growth of fry planted in the Salloomt will be assessed.

Contact: Jack Leggett, Regional
Fisheries Biologist, Fish and
Wildlife Branch, Williams
Lake.

Salloomt River Reconnaissance

A major falls, 4.5 km upstream, prevents anadromous fish passage to the upper Salloomt's 35.4 ha rearing area. Above the barrier, only Dolly Varden char is present; below the barrier, the stream is utilized by anadromous salmonids, particularly steelhead and coho. Prior to the barrier's removal, a detailed biophysical assessment was performed to determine probable benefits and costs. The Salloomt River reconnaissance identified the potential steelhead smolt yield at carrying capacity as 8,500 fish, to give adult returns of 680 at 8 percent smolt to adult survival, or 1,020 at 12 percent survival. Maintaining wild production at 8,500 smolts creates a harvestable surplus of 500 - 960 steelhead adults. The potential coho smolt yield was estimated at 75,000 smolts and additional adult returns of 5,000. The objectives of the 1981 work were to determine whether early (unfed) and late (fed) steelhead fry will survive and occupy headwater stream habitat in the densities predicted and to determine which fry group survives best when released into a "wild" rearing environment.

Following habitat assessment by carrying capacity analysis, 39,200 steelhead fry (1 g each) were stocked in fifteen sites by helicopter access in September. In October, 1981, population census (total removal) was conducted on twelve sites by standard electroshocking. The second fry release was carried out in mid-October, 39,600 fry (average 0.98 g each) were released in reaches predicted to support the most fry (these fry were dye marked).

Fry capture above the obstruction was made more difficult by the low conductivity, colder stream temperatures (4-8°C), and poor light conditions in early October. Fish electroshocked were close to or within the rock interstices--they were dark and displayed typical "overwintering" responses. Measured densities were below that expected for summer densities--more reliable measures of true fish abundance are likely to occur under better conditions in early September (the first reconnaissance was done in July, 1980). The maximum steelhead fry density above the obstruction (preliminary data) occurred in Site #1 (glide, boulder/cobble substrate) at 0.2 fry/m^2; this is reasonably close the the estimated potential of 0.22 fry/m^2.

The stocking program and carrying capacity assessment will be continued in 1982.

Steelhead enhancement of the Salloomt will increase the probability of catch in the Bella Coola-Atnarko system where steelheading values in 1981 were $11/angler day and annual net benefit of $500,000.

Contact: Ron Ptolemy, Fisheries
Biologist, Fish Habitat
Improvement, B.C. Fish and
Wildlife Branch, Victoria.

Camera Sidechannel Reconnaissance

Camera Channel, a 1.8 km-long side channel of the Atnarko River, is utilized extensively by steelhead trout and other anadromous salmonids for spawning. In 1979, deposition of fines from highway construction work destroyed spawning habitat. A subsequent study revealed that although some 40-50 female steelhead spawned in the channel, the egg-to-fry survival was less than 15 percent.

Six gravel spawning platforms were installed in Camera Channel in 1981.

The 15 percent survival rate is what can be expected for the entire system in an average year. There will be spawning sites within the river system where survival may be only five to 10 percent, due to poor substrate or high or low flows. On the other hand, survival rates in prime areas may reach 40 percent or better.

By introducing good quality gravel into the channel (which has a more stable flow than the mainstem Atnarko), the survival rate of steelhead fry is expected to increase to 25-40 percent. If the survival rate reaches 30 percent, this means that fry production will be doubled, to reach 40,000. (The estimated fry production in Camera Channel was 40,000 in 1980.)

Six gravel spawning platforms were installed in Camera Channel in September, 1981 to restore the channel's spawning capabilities. Each platform is approximately 10 metres long and seven metres wide, and the gravel depth is 30-60 cm. The project created a total of 415 square metres of spawning habitat.

Pink and coho salmon are already utilizing the platforms, and the spawning success of steelhead should be substantially improved by this project.

Contact: Tom Wilkinson, Fisheries
Technician, Fish and Wildlife
Branch, Williams Lake.

Gardner Canal Survey

Beak Consultants Ltd. carried out an adult biobaseline survey of the Kitlope, Tezwa, and Kowesas systems in Gardner Canal in 1981; a report of the

1979 adult work done by Envirocon on the Kemano River also became available.

Contact: Bruce Shepherd, New Projects Coordinator, Enhancement Operations.

Kitimat Pilot Hatchery

The Kitimat pilot hatchery for chinook, built in 1977, is located 2 km from the mouth of Kitimat River, at the Eurocan pulp and paper mill. The hatchery has a capacity for 100,000-150,000 chinook eggs for incubation in Heath trays. The resulting fry are reared for approximately five months and coded-wire tagged before release. This pilot hatchery serves two purposes: to build up the run of Kitimat River chinook to provide donor stock for the major production facility now under construction, and to provide biological information which will be applied at the new production facility.

In 1981, approximately 50 percent of the fry were transferred to net pens in a nearby warm water pond to reduce crowding at the hatchery. After rearing, these fish were released from the net pens and allowed to migrate from the pond into the Kitimat River.

Fish reared at the pilot facility were segregated into two groups: Hirsch Creek and upper Kitimat River. The fry were coded-wire tagged before release. When these marked fry return as adults in 1983-1986, the spawning grounds of both creeks will be surveyed; the proportion of the two groups of marked adults in each creek will help determine whether returning adults have strayed from their river of origin.

As in 1980, a significant proportion (50 percent) of the adult chinook returning to the Kitimat River in 1981 were of hatchery origin.

The rearing capacity of the pilot facility was increased in 1981, utilizing one of the wells developed in conjunction with the Kitimat production facility. Beginning with the 1981 brood, the pilot will be able to handle 250,000 chinook, 50,000 chum, 50,000 coho, and 10,000 steelhead eggs. This expansion will give existing staff experience in dealing with all major species slated for the production facility; it will also start to build chinook donor stock when the production facility comes on-line in 1984.

Contact: Dave McNeil, Stock Enhancement Officer, Bruce Shepherd, A/New Projects Coordinator, Enhancement Operations; Gregg Morris, Senior Project Engineer, Engineering.

Kitimat Production Hatchery

This new major production facility, to be operational in the fall of 1983, will be located on the highway 3 km south of Kitimat and 300 m downriver of the Eurocan pulpmill surface water intake. One of the most complex facilities to be constructed, it is designed to enhance nine chum stocks, seven chinook stocks, and four coho stocks within the Kitimat system and Kitimat Arm (Kildala and Dala Rivers and Bish Creek). Small numbers of sockeye and pink salmon and steelhead trout will also be enhanced.

A variety of hatchery techniques will be used in this facility;

- for chum: modified Atkins incubation to eyed stage (Heath tray incubation for some small stocks), Japanese keeper channels to hatch (Pallant boxes for some small stocks), Japanese rearing channels to release (Capilano rearing troughs for some small stocks)
- for chinook, coho, steelhead: Heath tray incubation, Capilano rearing troughs for initial rearing, raceways for final rearing (Capilano troughs for

final rearing of some small stocks)
- for sockeye and pink salmon: Pallant box incubation, then release.

Total production goals are:
- chum: 11 million eggs, 158,400 total adult production
- chinook: 3 million eggs, 64,500 total adult production
- coho: 592,000 eggs, 60,000 total adult production
- steelhead: 55,000 eggs, 1,000 total adult production
- pink: 500,000 eggs, 10,000 total adult production
- sockeye: 500,000 eggs, 4,000 total adult production.

Three water sources will be utilized: river water, semi-filtered river water, and well water.

In addition, Eurocan Pulp and Paper Mill Co. has agreed to provide waste heat to the hatchery, in the form of 4,500 lpm of 40°C uncontaminated water. This will allow heating of the river water sources, thereby allowing release of optimum sized fish during the natural smolt migration periods. The warmer water will also help keep the intake structure ice-free in winter.

By the year's end, approximately 20 percent of Kitimat hatchery was complete.

In 1981, the 3,310-sq m prefabricated steel hatchery building foundation and shell was constructed, and the interior works of the building was tendered.

In 1982, the rearing channels, fishway, intake structure and aeration tower will be constructed.

Contact: Gregg Morris, Senior Project Engineer, Engineering;
Bruce Shepherd, New Projects Coordinator, Enhancement Operations

Central Coast Reconnaissance/Feasibility

Bio-engineering reconnaissance surveys were conducted by helicopter and fixed-wing in July, August and September in B.C.'s Central Coast (Areas 9 and 10) to identify enhancement potentials. Various physical and biological characteristics were examined, including: salmon population size, spawning distributions, spawning ground quality and quantity, potential gravity water supplies, obstructions, and spawning and rearing potentials above obstructions. Consideration was also given to assessing groundwater potential on the basis of surface outflows and the physical characteristics of the watershed.

The specific systems and areas that were examined in Area 9 were: tributaries to Draney, Moses and Rivers Inlets, and Owikeno Lake. In Area 10, tributaries to Long Lake and Smith Inlet were examined.

Contact: Bruce Shepherd, A/New Projects Coordinator, Enhancement Operations;
Jim Wild, Senior Implementation Engineer, Engineering.

Table 13
Central Coast SEP Facilities*: Juvenile Releases 1981

Species	Brood	Group	Total Released	% Marked	% Survival	Avg. Size(g)
Bella Bella Hatchery						
Chum	1980	fed	50,000	N/A	N/A	1.2
Chum	1980	unfed	140,000	N/A	54.3	0.4
Bella Coola Hatchery						
Chum	1980	Fish Cr.	543,800	20.6	97.5	1.0
Chum	1980	Salloomt R.	998,500	10	91.4	1.0
Chum	1980	Snootli Cr.	756,000	N/A	97.6	1.2
Chum	1980	Nuhalk Cr.	520,100	N/A	96.0	1.2
Steelhead	1981	Salloomt R.	78,790	N/A	N/A	N/A
Kitimat Pilot Hatchery						
Chinook	1980	Hirsch Cr.	34,007	100	80.2	5 - 6
Chinook	1980	Upper Kitimat R.	26,886	100		5 - 6
Chinook	1980	Eurocan pond	56,600	N/A		5

*includes facilities constructed prior to SEP.

Table 14
Central Coast SEP Facilities*: Status at December 1981

Species	Stock	Brood	Stage	No. on Hand	Expected Release		
					Date	Number	Site
Bella Bella Hatchery							
Chum	McLoughlin Bay	81	egg	1,013,900	May 1982	525,504	McLoughlin Bay
Bella Coola Hatchery							
Chum	Necleetsconnay	81	egg	439,000	April 1982	395,000	Necleetsconnay R.
Chum	Salloomt	81	egg	596,000	April 1982	535,000	Salloomt R.
Chum	Snootli	81	egg	604,000	April 1982	543,000	Snootli Cr.
Chum	Nuhalk	81	egg	66,000	April 1982	60,000	Nuhalk Cr.
Chum	Fish/Air	81	egg	487,000	April 1982	438,000	Fish/Air Cr.
Steelhead	Atnarko	81	parr	6,800	May 1983	6,100	Salloomt R.
Chinook	Atnarko	81	egg	101,000	June 1982	81,000	Atnarko R./ Salloomt R.
Coho	Bella Coola	81	egg	62,000	June 1982	50,000	Bella Coola River
Kitimat Pilot Hatchery							
Chinook	Kitimat R.	81	fry	159,500	May 1982	130,000	Kitimat R.
Chinook	Hirsch Cr.	81	fry	25,500	May 1982	20,000	Hirsch Cr.
Chum	Kitimat R.	81	fry	35,000	April 1982	28,000	Kitimat R.
Coho	Kitimat R.	81	egg	57,500	Sept. 1982	46,000	Kitimat R.

*includes facilities constructed prior to SEP.

Table 15

Central Coast SEP Facilities*: Adult Production

	Expected Production from 1981 Releases		At Full Production		
Facilities/Species	Total Adult Production	Years of Return	Total Adult Production	Year	Contribution to Fisheries
Bella Bella Hatchery					
Chum	2,120	1984-1985	15,650	1988	25,724
Sockeye	--	--	1,340	1987	530
Coho	--	--	540	1986	381
Bella Coola Hatchery					
Chum	56,386	1984-1985	180,000	1989	124,740
Steelhead	400	1985-1987	--	1984	--
Kitimat Pilot Hatchery					
Chinook	3,525	1983-1987	157,000	1988	70,375
Sockeye	--	--	4,000	--	1,568
Chum	--	--	158,400	1985	118,800
Pink	--	--	10,000	--	6,000
Coho	--	--	92,000	--	55,200
Steelhead	--	--	1,000	--	500

*includes facilities constructed prior to SEP.

Queen Charlotte Islands

Public Participation Projects

Contact: Barry Peters, SEP Community Advisor, Terrace

Lyell Island Community

This project enhances chum stocks on Powrivco Creek on Lyell Island. In late 1980, seven volunteers planted 33,000 eggs. An estimated 30,000 fry were produced and then reared to one-gram size. The reared fry were released in July 1981. In the fall, 32,000 chum and 14,000 coho eggs were taken.

Frank Beban Logging Co. employees blasted the falls on Gate Creek, making an additional 3 km of spawning and rearing area available for coho.

Both schoolchildren and adults in this community are involved in this project.

Tasu Lions Club

Club members released 24,000 coho fry (Fairfax Creek origin) to Wright Lake in May. A final release of 24,000 additional fry to Wright Lake in June marked the end of another successful year for this project. In the fall of 1981, the Club took 58,000 coho eggs. Approximately 14 people were involved in 1981. A project which was planned in conjunction with Tasu School was not successful, due to water quality problems.

The project will continue in 1982, when the Club hopes to install another incubation box.

Steelhead Society of B.C.—Queen Charlotte Islands Chapter

Society members initiated this project to provide some baseline data on Copper Creek steelhead; this data would be used to manage the sport fishery. From December 1980, until the present, the Society, with cooperation from the Skidegate Band, has been conducting an ongoing tagging survey of steelhead on this system. About 170 steelhead were caught by anglers, then tagged and released.

In the spring of 1981, the Society's fence was used to trap steelhead kelts so that information could be collected from tagged fish.

Several tagged steelhead were recovered in a trap at the fence and several others were tagged and released to continue downstream. From this, a good estimate of population could be made. In addition, much was learned about downstream migration as it pertains to the native food fishery. To gather this information, the fence was monitored by Society members, 24 hours a day for six weeks.

A total of 30 people were involved with this project in 1981.

Steelhead Society of B.C.—Queen Charlotte Islands Chapter, Moresby Island

This project, involving six people in 1981, was initiated to learn more about the steelhead stocks in Pallant Creek. A second objective was to gather brood stock for a pilot hatchery project. The resultant fry wil be used to stock the presently inaccessible upper watershed.

In 1981, volunteers obtained 12 adult steelhead for brood stock. These fish were collected by angling, beach seining and netting while drifting the river. In addition, (to trace instream movements) adult fish were tagged with spaghetti tags.

Western Forest Products
Four full-time and eight part-time volunteers from this logging camp initiated a project on Sewell Inlet.

In 1981, six 50,000-egg boxes were constructed. However, heavy storms and problems with water intakes eventually limited the program to four boxes -- one each on Thorsen, Clint, Little Goose and Big Goose Creeks.

A total of 188,000 eggs were planted in the four boxes in 1981; of these, approximately 90,000 eggs lived to the fry stage. The fry were released into neighboring creeks.

Response to this new project has been extremely favourable within the community.

Gore Creek Group
The Group, based in Queen Charlotte City, initiated this project five years ago to rehabilitate the local coho run on Gore Creek, as well as to involve schoolchildren with salmonid enhancement activities.

In the spring of 1981, the creek bed began to shift, cutting off the water supply to the incubation box. In an attempt to rectify this problem, the six Group members installed approximately 30 metres of water pipe. However, the creek shifted again, and all 3,000 coho eggs (from Honna River stock) were lost.

In the fall of 1981, the Group took 16,000 chum eggs and 26,000 coho eggs. The resulting fry will be released into Gore Brook. In 1982, a new holding box will be built, with the help of members of the UFAWU. In addition, the group's visits to area schools were supplemented by talks from local fishery officers.

Skidegate Band
This new project (partially funded by the Canada Community Development Program) was initiated in 1981, to carry out stream studies and enumeration of adult sockeye on Copper Creek. The purpose of the project is to investigate enhancement and management opportunities for the native food fishery.

In 1981, three Band members tagged approximately 420 sockeye and completed inventories of five tributaries of Copper Creek. In addition, they salvaged fry during low water flows.

G.M. Dawson Senior Secondary School
Senior biology students studied several creeks in the Masset area for potential enhancement opportunities.

To make preparations to operate an incubation box for coho during the fall of 1981, the school managed to obtain a Youth Employment Program grant. The grant paid the wages of three students during the summer.

During 1982, the students plan to do some stream inventory work around Masset Inlet; equipment for water testing and stream surveying has already been purchased and tested. The students also plan to operate an incubation box on Deep Creek.

Port Clements Rod and Gun Club
In 1981, Club members initiated a tagging program for steelhead on the Yakoun River system. In late September, 220 steelhead were tagged with spaghetti tags. The tagging was followed up with tributary walks and river swims to recover the tags from spawned-out steelhead. Scale samples were also taken.

The Club hopes to continue this tagging program next year, as well as place an incubation box on Rennie Creek for junior Club members and for the school.

Taheyghen Elementary School

To learn about the life cycle of salmon, 19 pupils in this Masset school built an incubation box and incubated 150 chinook and coho eggs. The children enjoyed being "experts" to visitors to the classroom, and they became quite protective of their fish. Unfortunately, this project did not go to completion, due to water problems.

In 1982, the classroom incubator will be stocked with 200 eggs.

Barry Mark

Barry Mark, operating an incubation box for coho on Nadu Creek, released 8,825 fry in 1981. This project had an egg-to-fry survival rate of approximately 80 percent; about 100 of these fish are expected to return to the creek as adults.

Northern Trollers' Association--Masset

A project was initiated to reintroduce coho into Nadu Creek, a once-productive stream 15 miles south of Masset. The run was wiped out about 12 years ago as a result of improper culvert placement.

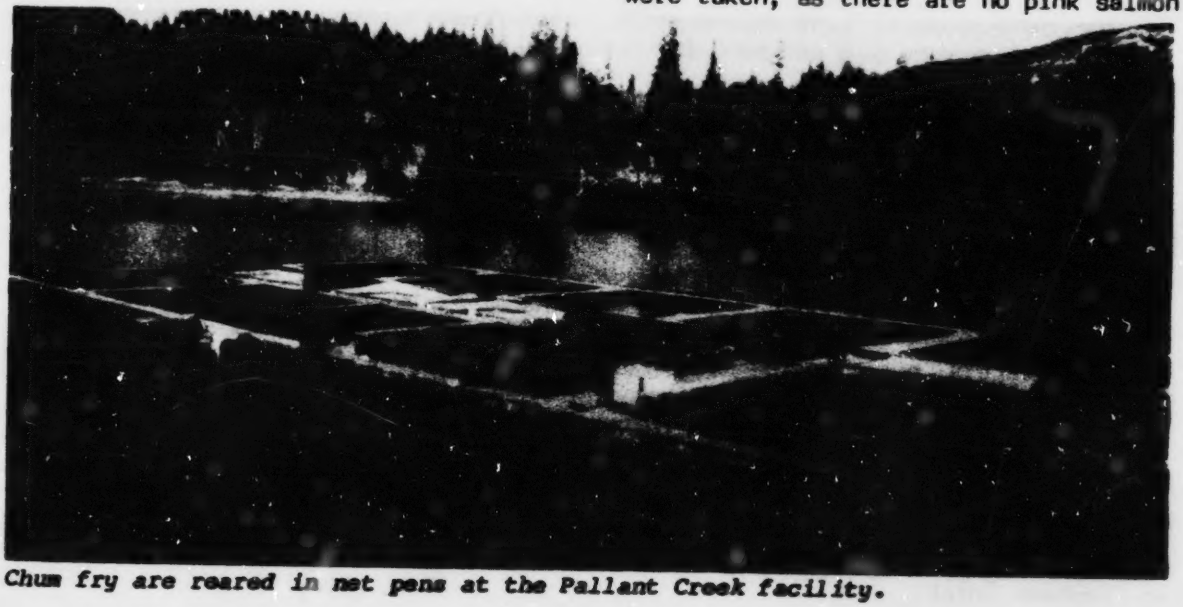
In 1981, the Association built and installed a 50,000-egg upwelling incubation box. A total of 16 male and 14 female adults were taken. Of these, two females and one male were killed by otters; one female spawned in the holding pen; and some of the females stripped were partially or totally spawned. However, approximately 11,100 eggs (of Millard and Gulley Creek origin) were planted. A total of 10,000 fry were produced; these were released into Nadu Creek.

The 17 Association members also cleared a logjam in Gulley Creek.

The Association will continue the project in 1982, and hopes to obtain more eggs.

Pallant Creek Hatchery

Pallant Creek hatchery, 48 km south of Sandspit in the Queen Charlotte Islands, is a modified Japanese-style hatchery for chum, pink and coho salmon. Built in 1978, it has a capacity for 10 million eggs. In 1981, 8,223,000 chum eggs and 235,000 coho eggs were taken. No pink salmon eggs were taken, as there are no pink salmon



Chum fry are reared in net pens at the Pallant Creek facility.

returning to the Queen Charlotte Islands in the "odd" years (1981, 1983, etc.).

The 1981 brood chum fry will be reared in the sea pens, and several marked groups will be released at various times. When these fish return as adults, in 1984 and 1985, they will be checked for marks at the Pallant Creek fence, so that reared fry-to-adult survival can be related to time of release.

Juvenile coho will be marked and released into upper Pallant Creek and Mosquito Lake. Returning adults will be checked for marks.

These marking/release studies are intended to identify release strategies which will maximize adult returns.

Engineering work completed in 1981 included modification of the original water intake to increase the water supply to the hatchery during the summer months. In August, the engineering maintenance crew constructed a concrete weir downstream of the intake, which will ensure a minimum water level at any time of the year. An opening fitted with stop-logs will allow fish passage, and it will also serve as a flushing-out system for sediment built up behind the weir.

A new warehouse was completed in the spring of 1982.

Contact: Pat Slobodzian, Stock Enhancement Officer, Enhancement Operations; Wai Leung, Senior Project Engineer, Engineering.

Mathers Creek Satellite Hatchery

This facility, located 10 km east of Beatty Anchorage on Louise Island of the Queen Charlotte Islands, was designed to enhance pink and chum salmon in Cumshewa Inlet.

The rearing facility for 1.2 million chum fry was built in 1980. Water quality testing of both ground and surface water identified potential problems for fish culture. As a result, 1980 brood Mathers Creek chum fry were incubated and hatched at the Pallant Creek facility. They were returned to the Mathers facility for rearing, and rearing success in surface water and "stripped" well water was compared.

Preliminary results indicate that growth was virtually identical in the two raceways, despite a slightly warmer temperature in the groundwater supply. Survivals to release were excellent. Representative numbers of each rearing group were marked prior to release. In 1983 and 1984, fish passing upstream will be checked for marks at the Mathers adult collection fence to compare reared fry-to-adult survivals for the two groups.

In 1981, 697,000 chum eggs were taken from Mathers Creek and incubated to the hatched stage, using "stripped" well water. No pink salmon eggs were taken, as 1981 was the "off" year for Queen Charlotte Island pink salmon.

Following an inspection of the facility by SEP engineers during the summer of 1981, several improvements and modifications were made. An additional apron was built downstream of the adult collection fence to prevent scouring of the streambed; the fence sill will not be undermined. A new storage tank for diesel fuel was installed at Beatty Anchorage, increasing the present storage capacity by 22,730 litres.

Contact: Russ Hilland, Support Biologist, Bruce Shepherd, A/New Projects Coordinator, Enhancement Operations; Wai Leung, Senior Project Engineer, Engineering.

Sachs Creek

Sachs Creek is located on the Queen Charlotte Islands, approximately eight kilometres west of Sandspit. The project was initiated during the 1980/81 fiscal year, when MacMillan Bloedel approached DFO in order to establish a contract for the company to become involved with salmon enhancement work in the Queen Charlottes. Subsequently, Sachs Creek was identified as a potential enhancement site through reconnaisssance, since the creek was the site of an erosion problem with the resulting depletion of the pink and coho stocks.

In 1981, 60,000 coho eggs were incubated. The resulting fry will be reared through the summer of 1982, tagged and planted in the headwaters of Sachs and Haans Creeks.

Contact: Gary Logan, Head, Small
Projects Unit, Special
Projects.

Masset Community Development Project

The Masset Indian Band, which has been involved with SEP since 1978, operates an enhancement project in the Yakoun watershed on Graham Island. In addition to the primary objective of increasing the depressed Yakoun River chinook stock, the project is intended to build up coho and sockeye stocks throughout the watershed.

In 1980, the Masset crew collected and incubated 231,000 chinook eggs. Approximately 77 percent of these were successfully incubated; the fry were reared and released in 1981. The eggs were incubated at the King Creek enhancement facility, and after initial ponding, the fry were transferred to floating net-pens at Marie Lake for rearing. The chinook were released in two groups, in an attempt to match the natural situation where some fish smolt early and some overwinter before smolting. The first release of 87,000 was on June 10 (at an average size of two grams); the second release of 92,000, at an average size of 3.5 grams, occurred on July 24. Approximately 25,000 fish from each group were coded-wire tagged and returns will be evaluated to determine the best rearing strategy.

The Band also collected 28,000 1980-brood coho eggs from King Creek and incubated them at the King Creek incubation facility. These fish were also successfully reared at Marie Lake, with releases back into King Creek in three groups (7,000 in July at three grams; 7,100 in November at 24 grams; 3,000 in March at 25 grams).

Biophysical reconnaissance work was carried out on Gold and Wilson Creeks to identify the characteristics of these streams and to locate potential enhancement sites (particularly for the siting of small incubation boxes). A 100,000-egg incubation box for sockeye and coho (50,000 each) was installed on Gold Creek.

In the fall of 1981, 145,000 Yakoun chinook eggs were collected. Coho eggs were collected from two creeks; 59,600 from King Creek, 49,000 from Gold Creek. In addition, 43,800 sockeye eggs were collected from upper Gold Creek and are being incubated at the Gold Creek incubation box.

An average of seven people were employed on this project throughout the year.

Contact: Colin Masson, Project
Coordinator, Special
Projects.

Table 16

Queen Charlotte Islands SEP Facilities: Juvenile Releases 1981*

Species	Brood	Group	Total Released	% Marked	% Survival	Avg. Size(q)
Pallant Creek Hatchery						
Chum	1980	production	2,747,000	8	92	1.5
Pink	1980	production	1,036,000	N/A	87.1	1
Coho	1980	Upper Pallant	36,000	98	79.1	4 - 6
Coho	1980	Mosquito L.	36,000	98	79.1	4 - 6
Sachs Creek Pilot Hatchery						
Pink	1980		53,355	N/A	N/A	N/A
Mathers Creek Pilot Hatchery						
Chum	1980	groundwater reared	96,430	52	91	1.2
Chum	1980	surface water reared	95,347	52.6	91	1.2
Chum	1980	not reared	201,931	N/A	91	0.45
Pink	1980	not reared	50,000	N/A	77.4	0.28
Masset Community Development Project						
Coho	1980	King Cr. (fry)	7,000	N/A	61	3
Coho	1980	King Cr. (smolts)	7,086	N/A		24
Chinook	1980	Marie L. pens	87,000	28.7	77	2
Chinook	1980	Marie L. pens	92,000	27.2		3.5

*includes facilities constructed prior to SEP.

Table 17

Queen Charlotte Islands SEP Facilities: Status at December 1981*

Species	Stock	Brood	Stage	No. on Hand	Expected Release		
					Date	Number	Site
Pallant Creek Hatchery							
Chum		81	alevin	7,312,000	May 1982	5,900,000	Cumshewa In.
Coho		81	alevin	235,000	July 1982	190,000	Pallant Cr./ Mosquito L.
Sachs Creek Pilot Hatchery							
Coho		81	egg	60,000	summer 1982		Sachs/Haans Creek
Mathers Creek Hatchery							
Chum		81	alevin	697,000	May 1982	560,000	Mathers Cr.
Masset Community Development Project							
Coho	Gold Cr.	81	egg	49,360	Aug. 1982	6,629	Gold Cr.
Coho	King Cr.	80	smolt	3,100	March 1982	3,100	King Cr.
Coho	King Cr.	81	egg	59,663	Aug. 1982	225	King Cr.
Chinook	Yakoun R.	81	alevin	142,800	Aug. 1982	57,000	Yakoun R.
Sockeye	Gold Cr.	81	egg	43,800	May 1982	6,629	Gold Cr.

*includes facilities constructed prior to SEP.

Table 18

Queen Charlotte Islands SEP Facilities*: Adult Production

Facilities/Species	Expected Production from 1981 Releases: Total Adult Production	Expected Production from 1981 Releases: Years of Return	At Full Production: Total Adult Production	At Full Production: Year	At Full Production: Contribution to Fisheries
Pallant Creek Hatchery					
Chum	54,940	1984-1985	145,800	1989	63,510
Pink	51,800	1983	--	1983	--
Coho	1,440	1983-1985	12,150	1986	5,443
Sachs Creek Pilot Hatchery					
Pink	1,334	1983	--	1982	--
Coho	--	--	7,500	1985	3,360
Mathers Creek Pilot Hatchery					
Chum	5,800	1984-1985	9,500	1989	4,138
Pink	1,250		--	1982	--
Masset Community Development Project					
Coho	1,851	1983-1985	1,620	1989	635
Chinook	5,370	1983-1987	6,480	1987	3,110
Sockeye	--	--	2,680	1989	1,501

*includes facilities constructed prior to SEP.

North Coast

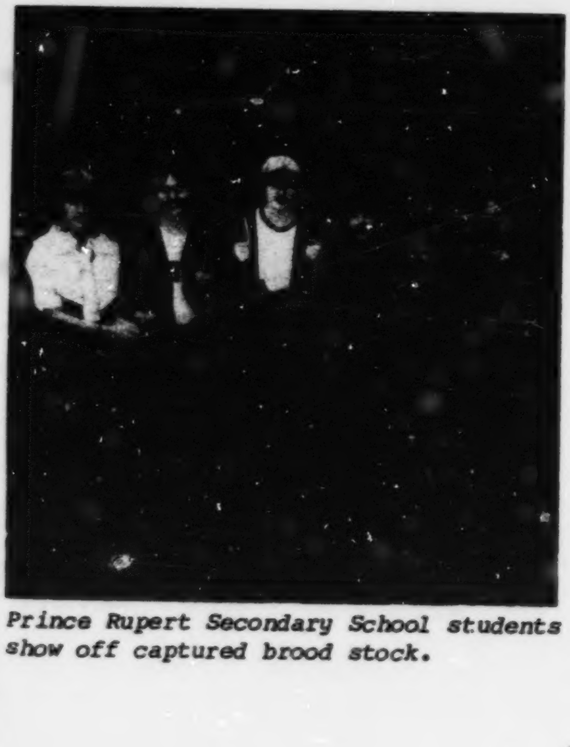
Public Participation Projects

Contact: Barry Peters, SEP Community Advisor, Terrace.

Northern Trollers' Association--Prince Rupert

The Association operates an incubation box on Kloiya Creek. The eggs collected in 1981 were of poor quality because the chinook spawners had difficulties jumping the fish ladder on Kloiya Creek. As a result, the mortality rate of the incubating chinook eggs was 85-90 percent; only 4,600 fry were released.

Approximately 15 people were involved with this project in 1981.



Prince Rupert Secondary School students show off captured brood stock.

In 1982, the Association is planning for production targets of 40,000 chinook at Kloiya Creek and 20,000 coho at Diana Creek.

Prince Rupert Senior Secondary School

This school project, under the supervision of teacher David Cook, was initiated to develop techniques for obtaining and incubating coho eggs and to involve school students in salmonid enhancement.

In 1981, two classes, plus members of the Rotary Club, overhauled an existing incubation box on Diana Creek, developed techniques for capturing Diana Creek spawners, constructed a holding pen for coho spawners (the structure was not used in 1981), constructed screens for the incubation box, and monitored the incubation and development of the coho eggs.

A lack of knowledge about the timing of the Diana Creek run and severe rainstorms and flooding limited brood stock capture--only two male and five female coho were taken. Approximately 80 eggs were planted; the fry will be released into Diana Creek in 1982.

The students are hoping that the project will be continued and expanded in 1982. Capture techniques were successfully developed (despite the limited brood stock capture) in 1981, and the students are hoping that more brood stock will be available for capture in 1982. This should result in a larger egg-take and thus an increased production of fry.

Conrad St. Elementary School
Under supervision of teacher Jim Pedersson, students built an in-class incubator and monitored the growth of 300 coho eggs. Because the project is permanently displayed in this Prince Rupert school, students have the opportunity to obtain hands-on experience and to study the development of the salmonid from the egg-to-fry stages.

James Wold
James Wold headed a group of 12 volunteers to increase coho stocks in Thornhill Creek, 16 km north of the Lakelse system near Terrace. The volunteers installed an incubation box on Eby Street and they subsequently planted 241,372 coho eggs. Approximately 140,000 fry were produced; 130,000 were released as fry, while the remainder were reared for a longer period and released as smolts.

About 15 classes of schoolchildren and about 300 adults visited the site.

In 1982, the group plans to take 400,000 eggs from brood stock in the Lakelse system.

Clarence Michiel Elementary School
During the fall, students and teachers at this school in Terrace operated an in-class incubator for 800-1,000 coho eggs. The students were very enthusiastic about monitoring the incubating eggs. Because egg-to-fry survival was almost 100 percent, and the rearing capacity of this project was limited, one-half of the fry were released soon after emergence.

This project has had an extremely high profile within the school.

In 1982, the students hope to continue to incubate coho and to rehabilitate Thornhill Creek for returning spawners.

Caledonia Senior Secondary School
During the year, students at this Terrace school did some downstream trapping of pink salmon on Thornhill Creek. Field trips were undertaken to the creek, and the biology class included salmon enhancement activities as part of a science fair. Unfortunately, other plans for salmonid enhancement projects were disrupted due

Clarence Michiel Elementary School students take their learning outdoors during a field trip to neighboring creeks.

to a teacher/school board dispute and subsequent strikes during the spring.

Nishga Elementary School
Six students and two teachers installed a 50,000-egg incubation box designed to increase the coho stocks of the Tseax River (a tributary of the Nass River). The group attempted to take eggs for the box, but high water hampered access to brood stock, and no eggs were taken.

Keith Hodson
Keith Hodson's project was initiated to open access to more than a half-mile of the Bulkley River backchannel for immature fish. A beaver dam, which had blocked access to the backchannel, was removed. Two people completed this project in 1981.

Steelhead Society of B.C., Bulkley Valley Chapter
In 1981, the Chapter carried out reconnaissance activities for enhancement opportunities for steelhead on the Telkwa River system. In addition, the 10 Chapter members radio-tagged three steelhead in an attempt to identify spawning areas.

In 1982, the Chapter will implement a steelhead tagging program on the upper Bulkley River.

T.J. Then
The objective of this project was to incubate chinook eggs, on an experimental scale, using water from ponds on T.J. Then's property in Smithers. About 2,000 chinook eggs were taken in the fall of 1981. The fry will be reared for a short time and released into the Bulkley River in 1982.

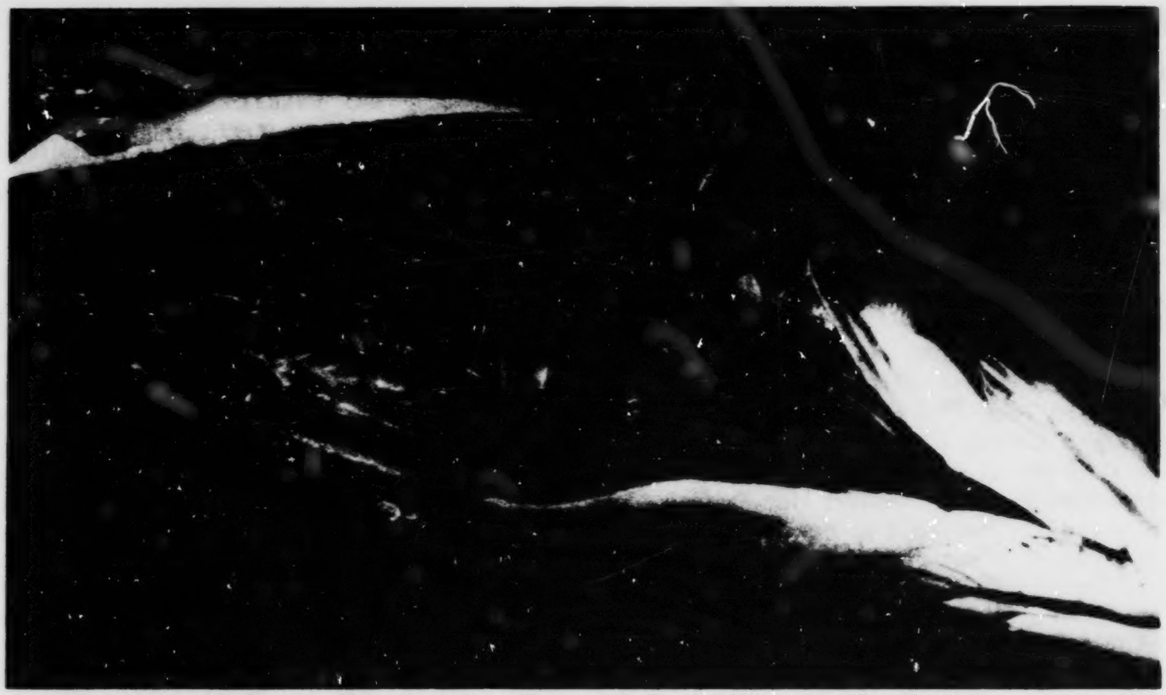
A. Groat
Fishery officer Al Groat operated a project to enhance chinook stocks in the Bulkley River. After the eggs hatched, he fed the fry and monitored the growth of the fish in the cold water conditions (temperature ranges from 1-5°C). He released 45,000 chinook (two-gram size) into the Upper Bulkley River.

Skeena Steelhead Radio Tagging

In 1981, radio tagging studies were carried out on the Kitsumkalum (Kalum) River, which flows south from Kitsumkalum Lake for 35 km before joining the Skeena River at Terrace.

Radio telemetry studies of Skeena steelhead have been carried out since 1978, but much of the work was directed towards identification of individual stocks of steelhead in the commercial gillnet fishery near Prince Rupert. However, smaller-scale telemetry studies, conducted recently on many of the major tributaries of the Skeena, have examined the movements of steelhead through the sport fishery, as well as wintering areas and time and location of spawning. Some rivers near Terrace, including the Kalum, sustain an increasingly popular steelhead sport fishery during the fall, winter and spring. Although substantial harvests occur, it is not clear if these fish are summer or winter run stocks. These considerations have a bearing on the identification of enhancement projects on the system. With increased urbanization and intensive logging creeping through the drainage, it is also necessary to identify and maintain spawning and rearing habitat.

In 1981, 22 adult steelhead were radio-tagged through the Kalum; an additional 44 steelhead were spaghetti-tagged so that their recapture by anglers could be determined. Movements of the fish were followed through a combination of strategically-located automatic scanning stations and routine radio tracking with truck, boat and aircraft. They were monitored until spawning time in the spring and many were tracked as they left the system as kelts (steelhead which have completed spawning).



A radio tag, which was inserted in the stomach of this steelhead, helps trace the movement of steelhead through the sports fishery.

Preliminary results from angling recaptures indicate that although there is a large steelhead harvest on the Kalum, the stocks do not appear to be suffering from the pressure. An amazing 36 percent of the radio-tagged fish spent at least part of their winter in Kitsumkalum Lake; this suggests that the lakes are important as wintering habitat, and important as a necessary relief from angling pressure. Spawning sites were located throughout the drainage, both above and below the lake. Half of the spawning sites were in tributaries, of which Deep Creek and Lean-to Creek were of importance. Although some of the remainder of the fish spawned in side channels of the Kalum, most were mainstem spawners that utilized the extensive gravel substrate found between Alice and Lean-to Creeks.

This project began in 1980 and was finished in 1981. No further telemetry work is anticipated for 1982, but with spawning and rearing sites identified, it is possible to carry out juvenile sampling for forecasting run strength or analyzing standing stock.

Contact: Mike Lough, Fisheries Biologist, Fish and Wildlife Branch, Smithers.

Kitsumkalum Pilot Hatchery

This pilot hatchery for chinook, located 60 km north of Terrace, began operations in 1980. Two 100,000-egg gravel incubation boxes were installed at Dry Creek, a tributary of Kitsumkalum Lake, and two Capilano-style rearing troughs provided a total rearing capacity for up to 100,000 fry. In spite of some fish health problems and poor growth rates during incubation and rearing, the hatchery released 63,422 chinook fry (from brood stock taken from the Kalum River in 1980) into the lower Kalum River in June, 1981.

In 1981, a stack of Heath incubators with an 80,000-egg capacity was added so that Cedar River chinook eggs could be incubated separately. Six additional Capilano-style troughs were installed. Therefore, it will be possible to rear Kalum River and Cedar River fish separately and to begin to assess time-and-size-at-release strategies for northern chinook stocks.

In 1981, approximately 71,968 eggs were taken from Cedar River chinook, plus 151,688 eggs from lower Kalum chinook. After rearing, four groups of 30,000 fry will be coded-wire tagged and released to their natural streams. The remainder of the fry will be released unmarked. From 1983 to 1986, the years these fry will mature, the spawning grounds will be surveyed for marked adults to determine the rate of survival for each group.

In order for biologists to evaluate the significance of low groundwater temperatures (low water temperatures caused poor growth rates), a heating system was incorporated in the new water supply system. The results of the study on this year's pilot operation are intended to define the feasibility of using this gravity-fed groundwater site for a larger facility. Two troughs have also been installed downstream of a beaver pond to evaluate the potential for passive solar heating of the impounded water.

Contact: Bruce Shepherd, A/New Projects Coordinator, Stu Barnetson, Senior Operations Support Technician, Enhancement Operations; Adrian Rowland, Project Engineer, Engineering.

Zymoetz River Chinook Enhancement

The Zymoetz River originates in the Hazelton mountains approximately 50 km west of Smithers and joins the Skeena River 10 km east of Terrace. In 1980, a small hatchery was constructed near the headwaters of the Zymoetz at Fossil Creek. This was stocked with 28,000 chinook eggs taken from spawners in the lower reaches of the river near Terrace.

The objectives of the pilot year of the program were to test the feasibility of:

- capturing and holding chinook in the lower river, near Terrace
- collecting the eggs and sperm, then transferring them by helicopter to the headwaters hatchery site for fertilization and incubation
- maintaining the water supply to the remote unmanned facility through severe winter conditions
- rearing the fry from emergence until mid-summer.

It is hoped that this will prove to be a potential method for enhancing the depressed Skeena River chinock stocks.

The pilot program was very successful. Fry began migrating from the gravel incubation box in early June, 1981. These fry were collected and reared to an average weight of 2.2 grams by early August. Approximately 19,000 fed fry (68 percent egg-to-fed-fry survival) were coded-wire tagged and released to the headwater rearing areas of the Zymoetz, above Fossil Creek. This area of the watershed is presently unutilized by chinook, although it is used by other anadromous salmonid species (steelhead, sockeye, coho).

The 1981 brood year egg-take was conducted in the lower reaches of the river. In total, 165,000 chinook eggs were collected. Due to the logistics of the larger egg-take, the eggs were incubated to the eyed stage at a facility built in Terrace, then transferred by helicopter to the headwater hatchery facility. Survival to the eyed stage was 87 percent. The eggs have since hatched, and the alevins are developing normally.

A rearing program will again be conducted in 1982 and the tagged fry will be released at various appropriate sites along the river. Approximately 150,000 eggs will be collected from the 1982 chinook run.

Contact: Sam Gidora, Biologist,
Special Projects.

Zymoetz River Steelhead Colonization

The Zymoetz River flows northwest into the Skeena River, nearly eight kilometres northeast of Terrace. From its source in the McDonell Lake chain in the Hazelton mountains, the Zymoetz flows approximately 84 km in a southwesterly direction, draining an area of roughly 3,000 sq km. Two major floods, in 1974 and 1978, plus construction and reconstruction of a natural gas pipeline adjacent to or within the river channel, expanding logging activity and continued com-mercial gillnetting at the mouth of the Skeena, have contributed to a recent, marked decline in numbers of steel-head. The Zymoetz River project was designed to enhance steelhead populations by:

- assessing juvenile steelhead habitat
- diverting Serb Creek, an extremely volatile tributary of the Zymoetz River
- rehabilitating spawning gravel at the outflow of McDonell Lake
- collecting adult steelhead brood stock
- rearing fry (in a hatchery or incubation box) from Zymoetz donor stock
- introducing enhanced fry into selected underrecruited areas between Dennis and McDonell Lakes.

Zymoetz River steelhead brood stock are held until sexually mature and then stripped.

In 1981, 49 adult steelhead were collected from the Zymoetz outflow of McDonell Lake. These fish were held until sexually mature and then stripped. The 33 female steelhead yielded 142,299 eggs (roughly 4,300 eggs per female), of which 112,905 (79 percent) survived to the eyed stage. Approximately 100,500 fry survived to colonize selected areas in the upper Zymoetz watershed.

In addition, an engineering assessment was solicited to determine the extent of maintenance and/or improvement required on the shortcomings of the Serb diversion structure.

In 1982, the 1981 fry introduction will be evaluated. Since current technology indicates that alternate-year fry plants are the most successful for steelhead, a subsequent Zymoetz fry plant is not planned until 1983.

Contact: Bill Chudyk, Fisheries Biologist, Fish and Wildlife Branch, Smithers.

Kispiox Band Project

The Kispiox Band has a contract with SEP to enhance chinook and coho stocks in the Kispiox River, a tributary of the Skeena River. This project is part of a long-term program to produce chinook and coho and to carry out some stream improvement work. Chinook stocks are under extreme pressure due to heavy interception in the Skeena sockeye and pink fisheries, hence the priority on chinook enhancement.

In 1981, the crew size ranged from two to 16 persons. They reared 1980 brood chinook and coho and tagged the fry with coded-wire tags before release. After successfully locating a new groundwater supply, the crew developed a pilot incubation and rearing facility utilizing the water supply. Band members also collected eggs and incubated 1981 brood chinook and coho.

The development of a new facility is the first priority of 1982, as the available water at the present facility is substantially below requirements for current and proposed future production levels.

Escapements of odd-year (dominant cycle) pink salmon have been enumerated for four years to provide a solid data base for enhancement of this species in the future.

Contact: Chris de Hrussoczy-Wirth, Project Coordinator, Special Projects.

Kispiox River Steelhead Enhancement Reconnaissance

The Kispiox River, a major tributary to the Skeena River, is located near Hazelton.

Regional fisheries managers have identified management problems and goals for Kispiox River steelhead stocks. Earlier regional studies and a steelhead radio-tagging program identified 14 Kispiox tributaries as potential sites for natural or semi-natural enhancement. In 1980, a detailed biophysical reconnaissance of these tributaries and selected areas of the mainstem Kispiox was conducted to outline steelhead carrying capacity and to identify opportunities for enhancement. Results of the 1980 investigations suggested that management and future enhancement should be based on an annual assessment program, not on the basis of one year of data collection. The objective of the 1981 program was to collect a second year of data on late summer steelhead densities, as the beginning of an annual assessment program.

In 1981, fish population estimates were conducted at 12 index sites in the mainstem Kispiox and tributaries. The majority of the sampling was conducted by electrofishing; one site used seines.

Analysis of 1981 data has not been completed, but the results will help to answer questions regarding annual steelhead fry recruitment, survival rate from fry to yearling, and the carrying capacity of fry and yearlings in the Kispiox system. Recommendations can then be made regarding enhancement options.

Enhancement work to be done in 1982 cannot be predicted until the project report is completed and analyzed by Regional fisheries managers. The annual assessment program will continue.

Contact: Dave Tredger, Fisheries
Biologist, Fish Habitat
Improvement Section, Fish and
Wildlife Branch, Victoria.

Suskwa River Steelhead Colonization

Since 1978, SEP has funded a project to bolster reduced steelhead trout populations on the Suskwa River. In essence, this program was designed to colonize steelhead in a Suskwa tributary, above a previously-impassible falls. Native Suskwa River steelhead brood stock was collected annually to produce fry for introduction to Harold-Price Creek, where one- to four-gram steelhead fry were released in preselected areas in mid-September.

A total of 32 adult steelhead were captured by anglers from the lower Suskwa River and from the area of the Suskwa-Bulkley River confluence from March through May. Captured steelhead were placed to mature sexually in two "hatchery mesh" pens, which were floated in a man-made pond adjacent to Skilokis Creek. Progressive records were kept on the physical condition of each fish.

Twenty-nine of the steelhead were held at the Skilokis Creek facility until May 26, 1981, when a warm rain in the mountains, coupled with spring runoff, caused Skilokis Creek (a usually passive tributary) to leap its bank and devastate the steelhead holding area. Escape or release of all penned fish terminated the 1981 Suskwa program.

Contact: Bill Chudyk, Fisheries
Biologist, Fish and Wildlife
Branch, Smithers.

Morice River Steelhead Enhancement

Assessment of steelhead enhancement opportunities in the Morice River system, south of Houston, began in 1980. At that time, efforts were concentrated on two known important steelhead spawning tributaries, Owen and Lamprey Creeks, with limited effort in other parts of the Morice system. As expected, the 1980 assessment suggested that Owen and Lamprey Creeks were very important as spawning and early rearing tributaries for steelhead. Age distribution of juvenile steelhead (primarily 0+ and 1+) suggested that these two streams were important for production of yearling and two-year-old parr migrants which would then rear to smolt stage in the mainstem Morice River. Recommendations from the 1980 assessment included: enhancement through a fry-stocking program, based on annual fry recruitment monitoring at selected index sites; and further analysis of the entire Morice system to obtain a total picture of Morice River steelhead production and enhancement opportunities.

Objectives of the 1981 assessment program were basically to test the 1980 assessment conclusions in Owen and Lamprey Creeks through collection of a second year of data; to monitor fry recruitment at several index sites for assessment of opportunities for a steelhead fry stocking program, and to expand the 1980 analysis to include more of the Morice system.

In 1981, fish population assessment was conducted in Owen and Lamprey Creeks, and some Morice River mainstem sites as a second year of annual recruitment monitoring. Assessment included reconnaissance of several major tributary streams not sampled in 1980. A total of 34 population estimates were conducted by electrofishing.

The 1981 field data analysis has not yet been completed. Preliminary results indicate much greater density of steelhead fry and yearlings in Owen and Lamprey Creeks in 1981, compared to 1980. Further analysis will create a better understanding of population dynamics and carrying capacity of juvenile steelhead in the Morice River system. This knowledge is necessary in prescribing appropriate enhancement plans.

Contact: Dave Tredger, Fisheries Biologist, Fish Habitat Improvement Section, Fish and Wildlife Branch, Victoria.

Upper Bulkley River Steelhead

This project is located on the upper Bulkley River from the Morice River confluence near Houston to the headwaters.

The project was initiated to assess the standing crop, carrying capacity and enhancement opportunities for steelhead in the Upper Bulkley watershed. Enhancement in this watershed will benefit steelhead anglers primarily in the Bulkley River below the Morice River.

In 1981, steelhead carrying capacity assessment was conducted by late summer population estimation at 24 sites throughout the watershed. The assessment covered all species present, including chinook salmon. All sampling was conducted by electrofishing.

Data analysis has not been completed. Results will outline the distribution of steelhead and chinook in the Upper Bulkley watershed; also, carrying capacity and smolt yield estimates will be derived.

Contact: Dave Tredger, Fisheries Biologist, Fish Habitat Improvement Section, Fish and Wildlife Branch, Victoria.

Babine Facilities

The artificial spawning channels on Fulton River and Pinkut Creek were constructed prior to the Salmonid Enhancement Program, and have been in full operation for more than 10 years. The 9.6 km of channels provide ideal spawning conditions for nearly one-half the total sockeye of the Babine system, which is a major sockeye producer for the Skeena River. Although 1981 sockeye escapements to most Skeena River and Babine Lake tributaries were poor, returns to the Pinkut and Fulton systems were excellent.

Fulton River Project

The two artificial spawning channels on the Fulton River are located approximately seven kilometres southeast of Granisle in central B.C. The water supply for the channels comes from Fulton Lake. Returns to the river and channels exceeded the capacity of the system in 1981. "Excess" fish spawned in the Fulton River, below the adult enumeration/diversion fence.

Pinkut Creek Project

This spawning channel, which produces about 44 million fry, is located on Pinkut Creek, 50 km northeast of Burns Lake. Returns to lower Pinkut Creek and the channel exceeded the spawning capacity in 1981. Consequently, 90,753 adult spawners were airlifted over the falls on Pinkut Creek and allowed to spawn in the upper creek. An additional 60,000 fish spawned below the adult counting fence, which was closed when Pinkut Creek and the spawning channel were loaded to capacity.

The water for this channel is taken out of Pinkut Creek and reaches the channel via a water supply tunnel.

In 1981, the bridge to the spawning channel site was repaired.

Contact: Colin Harrison, Stock Enhancement Officer, Enhancement Operations; John Beyer, Engineering Technician, Engineering.

Kincolith Band Project

During 1981, much work was done on the new hatchery site, although more work is needed in 1982 to complete the proposed facility. The completed facility will have an incubation capacity of 300,000 chinook eggs and 150,000 coho eggs, and associated fry-rearing facilities. The hatchery building, which houses an incubation room, office, and laboratory was completed. As well, most of the rearing troughs and pools were installed. A well was dug to a depth of approximately 10 metres, and the pumps, aeration tower, and associated plumbing were installed. Electrical power has been supplied to the hatchery site by the installation of a one-kilometre line from the village power grid. Alternate water sources were also tested for hatchery suitability.

In the fall of 1981, the Kincolith crew successfully collected 42,700 chinook eggs and 98,420 coho eggs. The severe 1981-82 winter proved to be disastrous for the Kincolith project. The primary water supply froze, and the back-up systems weremaintained by the crew under very difficult conditions. However, a water quality problem developed in the well water, resulting in a severe mortality rate among the incubating eggs.

With the continued support of the Small Projects engineering staff, the band will be able to develop an alternate water supply for the hatchery in 1982, and the hatchery will be completed as scheduled.

The Kincolith Band Council, under contract with SEP's Community Development Unit, employs two people full-time and up to eight people part-time on this project.

Contact: Colin Masson, Project Coordinator, Special Projects.

Tahltan River

The Tahltan River, a tributary of the Stikine River, is located approximately 102 km southwest of Dease Lake. A small timber storage dam and a fishway were constructed at the outlet to Tahltan Lake. Materials and work force were flown in by aircraft. The work was carried out by young people working in the Katimavik program. The water stored behind the dam will be released in the fall to augment the stream flows during the sockeye migration.

Contact: Rheal Finnigan, Senior Engineer, Special Projects.

Tuya River Feasibility

A bio-engineering inspection of the major obstruction on the Tuya River, a tributary of the Stikine River near Telegraph Creek was made by helicopter in July of 1981. The inspection was undertaken to determine the seriousness of the lower obstruction to fish passage, which appeared to be a major physical barrier to upstream migration. This conclusion was reinforced when no fish were observed between the two obstructions, although a local commercial fisherman suggested that the survey was conducted after the bulk of the spawners had migrated.

Therefore, the initial fishway proposal may have to be modified so that the fishway entrance is located below the lower obstruction. The cost of constructing a fishway at this location is estimated at $4 million.

Contact: George Nielsen, Senior Engineer, Engineering; Bruce Shepherd, A/New Projects Coordinator, Enhancement Operations.

Table 19

North Coast SEP Facilities: Juvenile Releases 1981*

Species	Brood	Group	Total Released	% Marked	% Survival	Avg. Size(g)
Kitsumkalum Pilot Hatchery						
Chinook	1980	Kitsumkalum R.	63,422	70.3	73.4	1.3
Zymoetz River Pilot Hatchery						
Chinook	1980	Zymoetz R.	18,800	100	68	2.2
Kispiox Band Project						
Chinook			67,000	94.9	44	3.1
Coho			27,550	91.5	27	2.5
Babine Facilities						
Sockeye	1980	Fulton Channel 1	8,000,000	--	49	0.152
Sockeye	1980	Fulton Channel 2	68,400,000	--	51.3	0.160
Sockeye	1980	Fulton R.	32,300,000	--	34.5	0.165
Sockeye	1980	Pinkut Channel	42,200,000	--	51.7	0.156
Sockeye	1980	Pinkut Cr.	10,800,000	--	34.1	0.157
Kincolith Band Project						
Chinook			4,000	N/A	67	1.5
Coho			0[1]	N/A	0	N/A

*includes facilities constructed prior to SEP.

[1] Mortality due to water flow problems.

Table 20
North Coast Facilities*: Status at December 1981

Species	Stock	Brood	Stage	No. on Hand	Expected Release		
					Date	Number	Site
Kitsumkalum Pilot Hatchery							
Chinook	Cedar R.	81	fry	63,800	June 1982	51,000	Cedar R.
Chinook	Kitsumkalum River	81	fry	136,000	June 1982	109,000	Kitsumkalum River
Zymoetz River Pilot Hatchery							
Chinook	Zymoetz R.	81	egg	165,000			
Kispiox Band Project							
Coho	Kispiox R.	81	egg	119,000	Sept. 1982	93,000	Kispiox R.
Chinook	Kispiox R.	81	alevin	68,855	Sept. 1982	65,000	Kispiox R.
Babine Facilities							
Sockeye	Fulton	81	egg	650,000,000	Jun 1982	175,000,000	Fulton R.
Sockeye	Pinkut	81	egg	295,000,000	Jun 1982	100,000,000	Pinkut Cr.
Kincolith Band Project							
Coho	Kincolith	81	egg	98,400	--	0[1]	--
Chinook	Kincolith	81	fry	38,000	--	0[1]	--

*includes facilities constructed prior to SEP.

[1] Water problems killed these fish.

Table 21

North Coast SEP Facilities*: Adult Production

	Expected Production from 1981 Releases		At Full Production		
Facilities/Species	**Total Adult Production**	**Years of Return**	**Total Adult Production**	**Year**	**Contribution to Fisheries**
Kitsumkalum Pilot Hatchery					
Chinook	713	1983-1987	1,620	--	593
Zymoetz River Pilot Hatchery					
Chinook	470	1983-1987	--	1987	--
Kispiox Band Project					
Chinook	2,010	1983-1987	2,560	1988	937
Coho	331	1983-1985	2,160	1987	913
Steelhead	--	--	1,050	1988	525
Babine Facilities					
Sockeye (Fulton)	837,000	1985-1986	1,125,000	1987	470,250
Sockeye (Pinkut)	432,000	1985-1986	540,000	1987	225,000
Kincolith Band Project					
Chinook	120	1983-1987	14,040	1988	4,802
Chum	--	--	4,010	1988	2,141
Coho	--	--	2,340	1986	1,095

*includes facilities constructed prior to SEP.

Federal Research

Juvenile Production Strategies

Size and Time at Release

The purpose of these studies is to determine the optimum size and time at release for juvenile salmonids in order to obtain maximum adult return. An initial coho study at Rosewall Creek experimental hatchery clearly demonstrated the importance of both factors.

Experiments are now in progress at Quinsam and Capilano production hatcheries and will likely be repeated three times at each location to examine annual variability in the conditions providing optimum returns. Planning for a chinook experiment at Quinsam hatchery was begun this year, with the first releases to be made in 1982.

a) Rosewall hatchery coho study

A final analysis of the data from the original Rosewall coho experiment is complete; maximum total adult returns (fishery plus escapement) are predicted for release of 25.1-g fish on June 22.

b) Quinsam hatchery coho studies

The first release was made in 1980. Smolts of three sizes (small, medium, large) were released on four dates (April 20, May 10, May 30, and June 19). Sampling at Quinsam in the fall of 1981 completed recoveries from these releases. Preliminary examination of the escapement returns indicates the effect of size was similar to that observed at Rosewall. Highest return of jacks resulted from the largest smolts for each release date; adult returns show a reverse, but less pronounced, effect, with the smaller fish generally giving the highest return. Highest jack return resulted from the release of large (29.5-g) fish on May 30; highest adult return was from small (19.8-g) fish released on the same date. The highest adult escapement return (three sizes combined) of 1.8 percent for the May 30 release was 2.1 times that of the next most successful (May 10) release. A complete analysis of these results, including returns to the fishery, will be done in 1982 and should result in a more precise "targetting" on the optimum size and time of release for Quinsam coho.

A second series of releases was made in 1981; release dates were identical to those of 1980 and fish were again classified into small, medium and large categories. Jacks from these releases were recovered at Quinsam hatchery this fall. For three of the four releases, the largest smolts again produced highest return of jacks to the escapement. Highest jack return was for a May 10 release, compared to May 30 for the 1980 releases, suggesting possible annual variability. Recovery of adults will be completed in the fall of 1982.

c) Capilano hatchery coho studies

Time and size studies began at Capilano this year, with the release of coho smolts of three sizes (small, medium, large) on four dates (May 7, May 28, June 18, July 9). Size categories were achieved by growth regulation, rather than by grading of populations (as was done at Quinsam and Rosewall). Preliminary examination of jacks recovered in escapement sampling last fall showed that returns (all sizes combined) for the first two release dates were essentially identical, at 1.06 and 1.09 percent, followed by 0.41 and 0.07 percent for the third and fourth releases, respectively. For three of the four releases, the largest smolts again produced highest jack returns. A second series of releases will be made in 1982. Adults from the 1981 juvenile releases will be recovered in the fall of 1982.

Steelhead Parental Age Studies

The studies are designed to examine the roles of environmental and genetic factors in determining age of steelhead at maturity. Such knowledge would allow hatcheries to achieve specific objectives, for example: production of fish with a longer ocean residence. These fish would be larger on return to the river and more desirable to anglers.

a) Rosewall Studies

In the spring of 1979, the first release was made from Rosewall Creek hatchery. These fish were the progeny of two groups of parents, one group (both male and female) having spent three years in the ocean before returning to spawn, the other only two years. Progeny of each type was graded into three size categories (small, medium, large) and coded-wire tagged before release. The first adults returned to Rosewall last spring, after two years in the ocean.

A total of 192 tagged fish was recovered. Final analysis cannot be done until 3-ocean adults are recovered in 1982. However, preliminary examination of the 1981 returns indicates a very strong influence of size--for both parental types, highest returns of 2-ocean adults resulted from larger smolts. The smolts from 2-ocean-parents produced three times as many returns of 2-ocean adults as the 3-ocean parents; however, it is possible these results occurred because of size differences alone, since smolts from 2-ocean-parents were larger on average at release. An unexpected predominance of males among returning adults suggests a tendency for male smolts to return at the early (2-ocean) age. Three-ocean adults from this study will be recovered in 1982.

In the spring of 1980, a series of releases was made from Rosewall Creek. Progeny from 2-ocean parents were graded into three size categories, tagged, and released at four dates. One release of size-graded progeny from 3-ocean parents also was made. First returns are expected in 1982.

The initial 1979 experiment was repeated in 1981 with the release, on June 8, of progeny from either 2-ocean or 3-ocean parents. Fish again were graded into three size categories and tagged distinctively before release. First returns are expected in 1983.

More detailed crosses were performed this spring to examine the effect of parental age on freshwater growth, as well as age of progeny at maturity. Thirty-two groups of fish resulting from 2 X 2, 3 X 3, 3 X 2, and 2 X 3 parental ocean-age crosses, using four sets of parents, were reared separately. These groups were sampled at regular intervals and are now tagged for release in 1982. Preliminary examination of growth data indicates very strong environmental effects, which will make it difficult to detect genetic contribution to growth rate. A repeat of this experiment, with a modified experimental design, is planned for 1982.

b) Oyster River Studies

A single release of 30,000 tagged smolts was made at the Oyster River in the spring of 1981. First returns are expected in 1983. These fish, progeny of 2-ocean or 3-ocean Oyster River parents, were incubated and reared at Rosewall hatchery. Fish were graded into three size categories before tagging. Another 22,000 Oyster River fish were reared and tagged at

Rosewall in 1981 in a repeat experiment, and they will be released in the Oyster River in 1982.

Adults from these steelhead studies will continue to return until 1985 and will continue to be monitored and sampled.

Accelerated Growth of Chinook

The purpose of this study was to determine whether hatchery-reared chinook smolts released at a larger size survive at a higher rate than smaller smolts.

Three releases of nose-tagged accelerated smolts have been made from the Big Qualicum hatchery, the last release being in 1978. Sampling of returning fish (which began in 1980) continued in 1981 and will be completed in 1983.

Age at maturity, survival, and growth of fish from these releases will be determined and compared with those of production fry.

Contact: Tom Bilton, Research Scientist; Bruce Morley, Biologist; Art Coburn, Technician, Fisheries Research Branch, Pacific Biological Station.

Lake Enrichment

Objectives of this major multidisciplinary program are to increase sockeye salmon production in B.C. through the controlled addition of nutrients (nitrogen and phosphorus) to oligotrophic (characterized by high oxygen, low organic, low nutrient content) nursery lakes; to determine the effects of fertilization on production at various trophic (phytoplankton, zooplankton and fish) levels; and to determine the suitability of untreated sockeye lakes as possibilities for fertilization.

Fertilization and Limnology

Commercial grade fertilizers containing 218 tonnes of inorganic nitrogen and 63 tonnes of inorganic phosphorus were added to 11 lakes (Great Central, Henderson, Hobiton, Kennedy-Clayoquot, Bonilla, Curtis, Lowe, Kitlope, Ian, Awun, Eden) in 1981. Fertilizer was added once weekly by helicopter to each lake through most of the growing season (April-May to September-October). Fertilizer additions commonly increased epilimnial (i.e. surface layer) nutrient loads during the main growing season by three- to five-fold.

Fertilizer composition (ratios of nitrogen to phosphorus) and application rates were varied among some lakes during 1981 to test whether such manipulations might be used to differentially stimulate responses by nannoplankton (plankton smaller than 20 μ m) rather than by larger net plankton. The former appear to be a "preferred" food source for zooplankton, which in turn are the major source of food for underyearling sockeye in the coastal study lakes. Results from these manipulations are encouraging and suggest that:

- between-lake differences in the mean standing crop of zooplankton are related more closely to between-lake differences in the quality of phytoplankton (i.e. amount of nannoplankton) produced through nutrient applications than to differences in the quantity of phytoplankton produced
- the quality of phytoplankton produced may be controlled to a considerable extent through "fine-tuning" of fertilizer composition and application rates
- year-to-year variations in lake climate affect both the quantity and quality of the primary production response in study lakes.

Contact: Ken Shortreed, Erland McIsaac, Fisheries Research Branch, West Vancouver Laboratory.

Table 22

1981 Sockeye Returns to Fertilized Lakes

Lake	Smolts Released (1979)	Predicted Adult Returns (in 1981)	Observed Returns
Great Central	14,688,000	660,960	848,000
Henderson	1,105,500	49,748	47,000
Hobiton	351,000	15,795	22,000
Long	3,601,620	162,072	375,000
Kennedy	1,800,000	81,000	N/A

Table 23

Sockeye Smolt Production[1] from Lake Enrichment in 1981 and Adult Production at Design Capacity[2]

				AT DESIGN CAPACITY		
Project	Type	Juveniles Released	Expected Adult Production	Adult Prod. (pieces)	Catch (pieces)	Catch (pounds)
Great Central L.	Fert.	10,236,000	460,620	1,797,000	1,096,170	5,371,233
Henderson L.	Fert.	1,356,000	61,020	572,300	349,103	1,710,605
Hobiton L.	Fert.	524,000	23,580	172,900	105,469	516,798
Kennedy L.	Fert.	841,000	37,845	600,000	366,000	1,793,400
Lowe L.	Fert.	220,000	9,900	307,600	187,636	919,416
Awun L.	Fert.	159,000	7,155	255,500	155,855	763,690
Eden L.	Fert.	267,000	12,015			
Ian L.	Fert.	--	--			
Sproat L.	Fert.	7,924,000	198,100	--[3]	--	--
Woss L.	Fert.	2,863,000	71,575	300,000	183,000	896,700
Bonilla L.	Fert.	106,000	4,770	43,500	26,535	130,022
Devon L.	Fert.	52,000	2,340	--[3]	--	--
Kitiope L.	Fert.	133,200	5,994	653,400	398,574	1,953,013
Curtis L.	Fert.	225,000	10,125	130,000	79,300	388,570

[1] 1981 juvenile releases are from the 1979 brood year stocks.

[2] When applied to lake enrichment, "at design capacity" refers to the carrying capacity of the lake.

[3] Capacity figures are unavailable.

Sockeye Ecology and Population Responses

In principle, addition of inorganic nutrients may enhance or alter trophic relationships so that sockeye will experience higher within-lake survival; attain larger size prior to seaward migration and then experience higher marine survival; and exhibit positive changes in stock size as a reflection of the sum of freshwater and marine survival effects. Consequently, where possible, sockeye have been monitored for changes in: freshwater growth, within-lake survival, marine survival and total stock (i.e. catch, escapement).

Juvenile Sockeye Assessment

Hydroacoustic surveys were completed to determine the distribution and relative abundance of limnetic (living in the open water) fish populations in 10 lakes undergoing nutrient treatment during 1981. Similar surveys were conducted on five untreated lakes in 1981 (Sproat, Long, Nimpkish, Mercer, Devon) to compare underyearling sockeye responses between treated and untreated lakes, as well as between lakes which, over the years, were sometimes treated and sometimes untreated. Midwater trawling was conducted on most study lakes to collect fish samples for species composition, growth, age and diet studies. Due to cost increases during 1981, surveys of juvenile sockeye were conducted only once on northern systems and two or three times on southern study lakes. Samples of sockeye smolts were collected at out migration from 13 of the lakes surveyed during 1981. These data have resulted in progress in assessing general effects of lake enrichment on juvenile sockeye growth and in forecasting prospects for enhanced marine survival.

Analysis of data indicates that:

- sockeye growth and smolt size attained are highly dependent on the size of the limnetic fish population (composed almost entirely of juvenile sockeye and in some cases, limnetic sticklebacks)
- the weight attained by sockeye smolts originating from enriched lakes is generally double that (i.e. average four gram) of smolts originating from untreated lakes
- given that published relationships between size and subsequent marine survival are reliable, it is not unrealistic to expect a two-fold increase in marine survival of sockeye from treated lakes
- increases in zooplankton standing crops promoted by lake fertilization have an obvious positive influence on smolt size attained by sockeye up to the point at which standing crops equal approximately five grams of zooplankton per fish. Maintenance of zooplankton standing crops at levels above this apparently saturates the growth response of sockeye and suggests that in our coastal lakes, there may be a ceiling of six to eight grams on smolt size
- preliminary analysis of published data and PBS data suggest that sockeye growth in coastal lakes is dramatically affected by even small increases in limnetic-fish population density between 100-2,000 fish/ha^{-1}. Once densities exceed this, additional reductions in smolt size achieved by sockeye are of smaller magnitude
- in at least seven of the coastal lakes currently being assessed, limnetic sticklebacks are abundant and represent the most important potential competitor of juvenile sockeye
- population densities of limnetic sticklebacks in unfertilized coastal lakes range from less than 100 to greater than 4,000 fish/ha^{-1} and since sticklebacks are roughly analogous to sockeye, they must influence both the carrying capacity of coastal lakes to support sockeye and/or influence the size of sockeye smolts produced in coastal lakes containing "limnetic" sticklebacks
- because of the dramatic effect that changes in limnetic-fish population density between 100 - 2,000 fish/ha^{-1} can have on sockeye growth, a feasible technique for removing or re-

ducing populations of limnetic sticklebacks would represent a potential tool for enhancing sockeye growth to an extent that rivals the effect of lake enrichment (i.e., in a number of lakes, reductions of stickleback populations could be expected to result in a doubling of sockeye smolt size).

Progress concerning assessment of within-lake-survival responses by juvenile sockeye to lake enrichment is more modest than that concerning growth responses. During 1981, within-lake-survival data on sockeye in Great Central Lake and Hobiton Lake under treated conditions and in Sproat Lake under untreated conditions were collected. Completion of any critical examination of the effects of lake enrichment on within-lake survival of sockeye in these systems must await future acquisition of comparative data on juvenile sockeye survival when the treatment status of these lakes is changed.

Contact: Dr. Kim Hyatt, Research
Scientist, Terry Gjernes,
Research Biologist, Fisheries
Research Branch, Pacific
Biological Station, Nanaimo.

Adult Sockeye Assessment

During 1981, there was additional effort to increase the reliability of estimates of escapement, total stock size and underyearling population size in enough lakes to constitute a representative sample of those that are currently being treated. This was accomplished by reallocating resources within the program to increase levels of effort on those key lakes (e.g. Great Central, Henderson, Hobiton, Sproat, Long, Bonilla, Curtis) where better data could be obtained and ignoring those lakes (e.g. Kitlope, Lowe, Kennedy, Nimpkish, Awun, Ian, Eden) where indices of adult sockeye response were likely to remain highly unreliable.

Of the lakes currently fertilized, Great Central, Henderson, Hobiton, Long and Kennedy had adult sockeye returning in 1981 that were progeny of a treated brood year.

1981 was an excellent year for sockeye returns to fertilized lakes, with approximately 400,000 more fish returning than expected. Although these results are encouraging, additional assessment will be required to determine the full extent of lake enrichment's contribution to these levels of production.

Contact: Dr. Kim Hyatt, Research
Scientist, Jim Manzer,
Research Biologist, Fisheries
Research Branch, Pacific
Biological Station, Nanaimo.

Stream Enrichment

The objective of this project is to maximize production of salmonid smolts by increasing natural food through enrichment under conditions of stable flow. In 1981, further trials were made at the Big Qualicum experimental channel with single additions of wheat grain to stream gravel. Responses of fish food-organisms amounted to 1.75 - 2.8-fold increases in weight of these organisms after one month. This is lower than in the initial trial. Because the increases were mainly from midge larvae, seasonal differences in response were expected. They were accompanied by a two-fold increase in numbers of oligochaete worms. Although these worms are not eaten directly by salmonids, they enter their food chain via midges.

Soybean proved as effective as grain, resulting in a two-fold increase in weight of benthos (the aggregate of organisms living in a body of water) in spring.

The relationship between benthic production and drifting organisms (the main foods of juvenile coho) was examined by collecting drift continuously for one month from enriched and unenriched troughs. No increase in drifting insects was associated with enrichment. Therefore, it appears that drifting insects are searching for food, and they are not increased by the addition of nutrients in the substrate. The benefits of enrichment are most likely to be passed to salmonids when the insects emerge and become available at the water surface.

Contact: Dr. Harold Mundie, Research Scientist, Fisheries Research Branch, Pacific Biological Station, Nanaimo.

Disease Control

Bacterial kidney disease (BKD) is a chronic disease of salmonids, thought to cause great losses in Pacific salmon once the fish have gone to sea. The responsible pathogen can be carried within the salmonid egg; the disease may therefore be maintained in nature by parent-to-progeny (vertical) transmission.

Attempts to prevent or control BKD by vaccination in sockeye have thus far failed. However, recent data suggest that other species of salmonids may be protected by vaccination. The efficacy of anti-BKD vaccination (eight different vaccine treatments) is being tested in coho salmon, with the results of these tests forthcoming.

Other work undertaken in 1981 on BKD control in hatcheries suggests that the risks of transmitting the disease through the egg can be greatly reduced by taking eggs only from fish with clear coelomic fluid. Such fish yielded pathogen-free eggs. In contrast, fish with cloudy coelomic fluid yielded

Drifting fish food organisms are collected from enriched and unenriched gravel in troughs.

eggs that carried the pathogen internally as well as externally; it was not always possible to free the eggs completely of the pathogen using current egg disinfectants and disinfection procedures. In many instances, eggs that were surface-sterilized still carried the pathogen internally. More effective internal disinfectants or disinfection procedures are obviously needed and are being sought. In the meantime, however, present egg disinfection procedures are still very worthwhile, because they substantially reduce the infectious load (and therefore the risk of infection) associated with the eggs.

Contact: Dr. Trevor Evelyn, Research Scientist, Fisheries Research Branch, Pacific Biological Station, Nanaimo.

Disease Diagnostic Services

The Diagnostic Service, based at PBS, provides a broad range of services relating to fish health matters in all fields of microbiology, including virology, bacteriology, histology and parasitology. Service is extended to all federal government agencies and private fish culturists rearing salmon in salt water. In addition to providing a diagnostic and advisory service in the event of disease outbreaks, the unit routinely monitors the health of fish in salmon enhancement facilities.

Whenever they occur, kills among both wild and cultured salmon are investigated to determine the role of infectious disease agents. The occurrence and distribution of these agents within B.C. and the Yukon Territory are monitored. Organisms known to cause high losses among cultured salmonids are of particular concern.

During 1981, 338 cases were processed. Approximately 78 of these involved active disease outbreaks at federal enhancement sites. An additional 13 cases involved similar problems at private facilities. Fortunately, losses were kept to a minimum in most cases. Much of this success is due to an increased awareness of the importance and influence of hatchery management strategies on fish health. Since the disease mapping activity carried on by the Service has shown that all of the major agents have a wide distribution, eradication is probably an unrealistic goal in all facilities except those utilizing closed or ground water systems. Disease control will therefore continue to depend heavily on hatchery management techniques and the use of vaccines.

Disease mapping has also shown that some usually innocuous organisms can, under certain circumstances, cause prespawning losses among migrant adult salmon. For example, the gill fungus Dermocystidium, a fairly common organism, has been associated with prespawning losses in the upper Fraser River drainage. No previously unencountered organisms were isolated in 1981.

Contact: Gary Hoskins, Fish Health Biologist, Pacific Biological Station, Nanaimo.

Controlled Reproduction

The objective of this program is to develop new methods and improve existing procedures for the controlled reproduction of salmonids so as to facilitate stock enhancement, increase the landed value of the catch and provide new options for the management of the fishery. Also funded in this program is research on the effect of hatchery loading density on ocean survival.

Contact: Dr. Ed Donaldson, Section Head, Fish Culture Research, Fisheries Research Branch, West Vancouver Laboratory.

Controlled Sex Differentiation

Major progress in developing techniques for controlling sex differentiation in Pacific salmon was achieved in 1981. The purpose of this work is to provide benefits to the commercial and recreational fisheries through the selective production of all-female or sterile groups of Pacific salmon.

An enhanced production of females will result in an increased egg take from a given escapement, a reduction in the incidence of jack salmon and an increased value of the catch where the roe is valued separately.

The production of sterile salmon smolts will delay or prevent sexual maturation and, therefore, delay or prevent the adult anadromous migration. The result will be a larger salmon that remains available to the fishery for a longer period of time. The production of jacks will also be eliminated.

Preliminary results of the May, 1980 pilot release of all-female and sterile coho salmon from Capilano hatchery were obtained in 1981. As expected, the all-female group returned to the hatchery while the sterile group did not. Returning females were identical to normal production fish in body and gonad size. Analysis of subsamples of both groups held in net pens at the Pacific Biological Station in Nanaimo indicate that while the sterile fish initially grew at a slightly slower rate than the females, they continued to grow through the period of normal maturation. By November, 1981, both groups attained a similar body size. Continued growth of the sterile group will be monitored through 1982. Coded-wire tag recoveries indicate that both groups contributed at a similar rate to the commercial troll and net fisheries. Contribution to the recreational fisheries will be assessed in 1982. Also, the continued contribution of the sterile group to both commercial and recreational fisheries will be assessed. In the spring of 1982, 80,000 Capilano coho will be sterilized for a second pilot release in 1983.

All-female groups of chinook and coho resulting from the use of milt from genetically female fish were produced for the first time in 1981. These results confirm female homogamety (existence of two similar sex chromosomes in the female) in both species and open the way for the production of all-female groups suitable for broodstock purposes. The "female" milt was used for the first time on production chinook from the Capilano hatchery. These fish are due to be released in the spring of 1982. This technique will be applied to Birkenhead chinook in 1982 to assist the rehabilitation of this run.

Additional experiments to be conducted in 1982 at the West Vancouver Laboratory include the testing for male heterogamety (existence of two dissimilar chromosomes in the male) in chinook salmon; the development of sterilization and masculinization techniques for chum salmon; the determination of effective treatment timing in coho and chum and the continued monitoring of sterile chinook and pink salmon.

Contact: George Hunter, Salmonid
Reproduction Biologist,
Dr. Ed Donaldson, Section
Head, Fish Culture Research,
Fisheries Research Branch,
West Vancouver Laboratory.

Induced Ovulation and Spermiation

Suboptimal adult holding conditions in fresh water or sea water can result in male and female salmonids maturing at different times, prespawning mortality or failure to spawn at the optimal time for enhancement purposes. In this project, techniques are being developed to regulate time of final maturation and ovulation in females and spermiation in males. Radio-immunoassay during 1981 of plasma samples collected in 1980 from maturing coho salmon treated with a synthetic analog of the hormone LH-RH revealed that the treatment had induced a significant increase in circulation gonadotropin, which lasted four days. This information was used in the fall of 1981 to design an experiment showing that it was possible to induce ovulation in a significant proportion of maturing coho with a single injection of the appropriate dose of the LH-RH analog. Administration of two injections resulted in an even higher success rate. This analog of LH-RH was synthesized in Vancouver by Syndel Laboratories under a technology transfer contract and now is available for use.

Contact: Dr. Ed Donaldson, Section Head, Fish Culture Research; George Hunter, Salmonid Reproduction Biologist; and Glen Van Der Kraak, Graduate Student, Fisheries Research Branch, West Vancouver Laboratory.

Fertility of Eggs and Sperm from Chum Salmon Held in Salt Water

In modern chum hatcheries, adults are frequently spawned after capture and holding in sea water. Since reduced fertility is often observed under these conditions, a study was carried out at the West Vancouver Laboratory to identify factors responsible for this. Female fish with poor egg fertility showed a distinct imbalance of ions in the ovarian fluid, indicating poor osmoregulation under saltwater conditions. Sperm was generally low in volume and poor in quality. Additional stress placed on the adults did not further influence gamete quality.

Contact: Dr. Joachim Stoss, Research Scientist, Fisheries Research Branch, West Vancouver Laboratory.

Low Temperature Preservation of Sperm

The storage of sperm cells results in preservation of genetic information. Therefore, a technique to keep milt indefinitely would be useful for the management of salmon populations (establishment of gene banks from endangered stocks), mariculture purposes (preservation of milt from superior fish) and the production of mono-sex fish stocks (preservation of "female" milt).

Milt from chinook, sockeye, pink, chum and coho salmon was frozen in small pellets and stored at -196°C in liquid nitrogen. Fertility remained high in all species and was 97 percent of the control value with the best treatment tested.

This technique was applied in 1981 for the preservation of milt from seven chinook salmon at Chilliwack hatchery. Further, frozen milt from genetically female Capilano chinook was used for the production of all-female offspring.

Contact: Dr. Joachim Stoss, Research Scientist, Fisheries Research Branch, West Vancouver Laboratory.

Gynogenesis - Polyploidy

Development of unfertilized fish eggs can be induced artificially by a process known as gynogenesis. The offspring obtained are almost identical to their mothers: they are female and highly inbred. With a similar manipulation, the number of chromosomes can also be multiplied, resulting in polyploid and possibly sterile fish. (Polyploid fish may have a faster growth rate than normal diploid fish. Triploid fish may be sterile.) However, the success of either induced gynogenesis or polyploidy in fish has been very limited and reliable procedures are currently being developed. So far, gynogenetic offspring in coho and pink salmon have been produced.

Contact: Dr. Joachim Stoss, Research
Scientist, Fisheries Research
Branch, West Vancouver
Laboratory.

Effects of Hatchery Loading Density

In animal husbandry, it has been clearly established that crowding induces a stress state that results in a general deterioration of the animal. The objective of this study is to determine whether current hatchery ponding densities of juvenile salmon may be inducing stress and, if so, to determine the effect on the return rate of the adults. At Capilano hatchery, juvenile chinook were raised at four densities, ranging from 120,000 to 380,000 per pond. In each pond, fish shorter and longer than the mean length were tagged with coded-wire tags. Samples, currently being examined, were taken from the two groups for determination of proximate analysis, plasma cortisol concentration and interrenal tissue histology.

In 1980, coho smolts were raised at three densities. At each density, fish of small, medium and large size were tagged distinctively and released. Preliminary assessment of returns of tagged adults to the fishery supports the results from previous returns, indicating that the adult return rate is lower with higher ponding densities. Furthermore, larger smolts at each density have a higher rate of survival to the adult stage. In 1982, the effect of loading density will be studied during warm-water rearing at Quinsam hatchery.

Contact: Ulf Fagerlund and Jack
McBride, Research Scientists,
Fisheries Research Branch,
West Vancouver Laboratory.

Fish Nutrition

Studies involve the development and testing of practical dry diets (using Canadian ingredients) for the culture of chinook and coho salmon at hatchery facilities. The work is directed toward:

- using nutritional means to improve ocean survival (adult returns)
- determining how nutrition reduces the effects of non-infectious diseases in salmonids
- defining optimum processing conditions for maximizing protein quality of herring meal for chinook salmon
- defining optimum protein and energy balance in chinook salmon diets, using high quality protein sources
- improving lipid quality in coho salmon diets
- controlling coho salmon growth by nutritional means
- developing diets for cultured chum fry
- determining probable nutritional causes of bilateral lens cataract incidence in hatchery stocks of juvenile chinook and coho salmon
- establishing a comprehensive diet quality control service for locally manufactured and imported feeds
- facilitating establishment of local fish feed manufacture.

There were several major findings in 1981. At Quinsam hatchery, growth of coho that were fed WV1 (West Vancouver 1) dry diet was greater than the growth of those fed Oregon moist pellets (OMP). Returns of jacks to the Quinsam hatchery in the fall of 1980 were: 1.46 percent for those fed WV1 diet, 1.41 percent for WV2, and 1.44 percent for OMP. A diet test comparing the performance of juvenile coho fed WV1 or OMP was suspended because of high cataract incidence in all groups, induced by one or more poor batches of OMP, before the experiment began. At Robertson Creek hatchery, chinook fed WV32 dry diet with nine or 18 percent lipid content had equivalent or better growth, food conversion and survival, up to release time, than those fed OMP. Jack returns from 1979 diet trials were two-fold higher for WV diet groups than for OMP-fed fish. Predicted adult survival for each diet is 4.5 percent for WV30 or WV40 and three percent for OMP.

At Robertson Creek hatchery, tagged groups of chinook salmon of similar size but of different body lipid and fatty acid content were released simultaneously to ascertain whether it would be advantageous for smolts to have high lipid content (increased body energy reserves) during the transition from artificial to natural food.

At Rosewall Creek hatchery and the Pacific Biological Station (PBS), no differences in survival were noted between fish fed one of six test diets (altered levels of vitamin C and minerals) and OMP following artificial challenge with bacterial kidney disease. Processing temperature during drying of herring was found to be most important in determining meal quality.
Improper drying temperatures lead to growth depression and poor food (protein) utilization in juvenile chinook salmon. Dietary protein and energy levels can be substantially reduced without loss of chinook salmon performance when highly digestible, well-balanced diets are fed. Moreover, chinook salmon growth rates can be enhanced well above that possible with OMP.

At West Vancouver, it was shown that canola oil offers promise as a supplemental lipid source in practical diets for coho salmon. Canola oil is less susceptible to oxidative rancidity and is more readily available than marine oils.

A collaborative study indicates that optimum size and time of release targets for coho can be obtained by feeding a "diluted" dry diet instead of by manipulating OMP ration. At West Vancouver, chum fry had similar performance when fed regular or freeze-dried OMP or Biodiet. Therefore, dietary moisture content does not appear to influence whether or not the fry will eat it.

The preliminary evidence from extensive chemical analyses of batches of OMP from Qualicum, Puntledge and Capilano hatcheries points to a possible dietary zinc deficiency. An experiment has been designed to test this theory. An intensive diet quality control program for 1982 has been submitted to the Department of Supply and Services for competitive bids. The program proposes to chemically evaluate the quality of marine oils, fish meals and finished diets. Approval-in-principle is being sought from the Procurement Review Committee for funds from the Source Development Fund to manufacture local fish feed. For maximum flexibility, a plant to produce a combination dry food (< 10 percent moisture) and semi-moist (30 percent moisture) food is being proposed. This work should help to establish a local fish feed industry and associated diet quality control. Diet formulations will be designed to control growth and improve health and ocean survival of hatchery-released smolts. Considerable economic benefits may be realized by these activities.

Work in 1982 will include:
- compiling coho and chinook returns from dietary trials at Quinsam and Robertson Creek hatcheries
- determining acceptable dietary components for pink salmon fry and studying the interaction between diet composition and time of freshwater residency on performance of pink fry
- identifying the nutritional basis for bilateral lens cataract incidence in juvenile chinook salmon
- determining influence of body lipid composition on ocean survival of juvenile chinook salmon at Robertson Creek hatchery
- improving lipid quality in chinook salmon diets
- comparing performance of coho and

chinook salmon fed West Van dry diets at Quinsam and Qualicum hatcheries.

The success of dietary treatments, compared with commercial diets, is constantly evaluated for each species. This covers growth, appetite, food and protein utilization, survival, health, osmoregulatory ability and adult returns (hatchery studies). Recommendations for suitable coho, chinook and chum diets should be made between 1983 and 1985.

Contact: Dr. Dave Higgs, Research Scientist, Fisheries Research Branch, West Vancouver Laboratory.

Smolting Requirements

This research is conducted to measure the ability of juvenile salmon to adapt to sea water, as influenced by rearing environment, size, and time of release. The purpose is to determine optimal rearing conditions for juvenile salmon and to evaluate a 24-hour seawater challenge test as an index of marine survival.

In the spring and early summer of 1981, regular samples of coho from time-and-size-at-release experiments at the Quinsam and Capilano hatcheries and samples of steelhead trout at the Rosewall Creek hatchery were taken for seawater challenge tests. The results will be compared with the rate of adult return in each of the release groups to evaluate the seawater challenge test. In addition to the challenge test, samples of gill tissue were collected from the coho at Capilano for measurement of the enzyme sodium, potassium ATPase. (ATPase has been widely used as an index of smolting in hatcheries in Washington and Oregon.) Results of the challenge tests and the ATPase measurements were in good agreement, indicating a peak readiness for adaptation to sea water during the last week of May.

The ability of juvenile fall chinook salmon to adapt to sea water was studied in laboratory experiments. The results indicated a very strong correlation with size and the ability of this species to adapt to sea water. In 1982, a regular sampling program will be conducted at the Quinsam hatchery in conjunction with a time-and-size-at-release experiment for chinook, and at Capilano in conjunction with a second experiment on coho.

Growth Control

The purpose of this work is to determine the best strategy for the use of temperature and rations to control growth of juvenile salmon for a predetermined size and time of release from hatcheries. The first experiment, started in 1980 with coho fry held at 10°C, demonstrated that food limitation during the early part of the rearing period, followed by a high feeding rate during the last months prior to release to sea water, is a successful technique for producing smolts of optimal weight and uniform size. Smolts from this experiment were transferred to seawater net pens in 1981 and reared until mid-October. Growth rate and percent survival in sea water were similar in three groups that had very different ration histories in fresh water.

A second experiment was started in 1981 to examine the effect of different forms of ration limitation on growth and smolting of coho reared under seasonally fluctuating temperatures. It will be concluded in mid-1982.

Contact: Dr. W. Craig Clarke, Research Scientist, Fisheries Research Branch, Pacific Biological Station, Nanaimo.

Stock Identification

Stock composition of the Barkley Sound-Alberni Inlet sockeye catch can be identified by use of specific parasite tags. The identifying parasites are two myxozoan protozoa: Myxobolus neurobius, a brain parasite, and Henneguya salminicola, a muscle parasite. Great Central sockeye are characterized by absence of both parasites, Sproat sockeye by presence of the brain parasite, and Henderson sockeye by presence of both parasites.

In 1981, sockeye samples obtained from test fishing 12-18 hours prior to the weekly commercial fishery openings were used to make weekly estimates of the stock composition in the Barkley Sound area. These estimates were used as an aid to manage the commercial fishery. In June, the stock consisted almost entirely of Great Central and Sproat Lake fish, with the former reaching its peak of approximately 65 percent of total stock in the area in late June. In early July, Henderson Lake fish began to form significant proportions of the stock, increasing to 30-40 percent near the end of the month when the fishery was closed. Samples from test and commercial fishing provided information on routes of migration of individual stocks in the Barkley Sound-Alberni Inlet area and indicated that Henderson lake sockeye may migrate at least nine-11 km up Alberni Inlet before dropping back to migrate through Uchuklesit Inlet into Henderson Lake.

In addition to providing information for the Barkley Sound-Alberni Inlet sockeye fishery, the project provides valuable data to assess the enrichment program in Great Central and Henderson Lakes.

Exploratory work was undertaken to determine if Myxobolus neurobius might also be useful in separating Nass River sockeye stocks. Samples of brains from sockeye escapements of four stocks in the Nass River system were collected in September, 1981 and examined for this parasite. It was found in 75 percent of Damdochax Lake sockeye, but was absent from Meziadin, Fred Wright, and Bowser Lake samples. These findings indicate that Damdochax Lake sockeye can be distinguished from the others in a mixed stock fishery, using this parasite-tag.

Contact: Dr. Leo Margolis, Research Scientist, Fisheries Research Branch, Pacific Biological Station, Nanaimo.

Incubation and Water Quality

The objective of this program is to define water quality criteria for salmonid eggs during incubation and to optimize certain procedures associated with egg and alevin culture in salmonid hatcheries.

Contact: Dr. Don Alderdice, Program Head, Fisheries Research Branch, Pacific Biological Station, Nanaimo.

Dissolved Oxygen and Un-Ionized Ammonia Levels

This project sought to establish maximum acceptable levels of un-ionized ammonia in relation to dissolved oxygen supply. Egg and alevin survival, incidence of white spot disease, and alevin quality (size) were examined. The data will provide recommendations on loading rates in incubation facilities. The project now is complete and will be reported during 1982.

Contact: John Jensen, Biologist, Fisheries Research Branch, Pacific Biological Station, Nanaimo.

Temperature and Egg Development

Data from experimental studies and from the literature have been gathered for all species of Pacific salmon and steelhead trout to determine incubation time (fertilization to 50 percent hatch), egg mortality associated with incubation temperature level, alevin size related to temperature, and optimum ponding time. The project is complete and will be reported during 1982.

Contact: Frank Velsen, Biological
Technician, Fisheries
Research Branch, Pacific
Biological Station, Nanaimo.

Total Gas Pressure (TGP) and Steelhead Egg Development

Various hatchery water supplies have shown dissolved nitrogen gas levels higher than saturation. In combination with dissolved oxygen, TGP ($O_2 + N_2$) in some systems has been greater than 100 percent. These high levels may create problems during egg incubation and alevin growth. At oxygen-to-nitrogen gas ratios of 1:1 (TGP--102, 106, 110 percent; temperature--8°, 10°, 12°C; water hardness--10, 100 mg/L as $CaCO_3$), adverse effects were noted at 110 percent TGP, 12°C and 10 mg/L hardness. A final study considered TGP levels of 100-110 percent at O_2:N_2 ratios other than 1:1 (dissolved oxygen--50 to 100 percent, dissolved nitrogen--100 to 126 percent of saturation); under those conditions, TGP had no effect on fertilization rate, egg survival during incubation, length of incubation period, or incidence of white spot disease (coagulated yolk syndrome). However, at combined lower oxygen-higher nitrogen levels, both embryonic and alevin growth rates were reduced. In addition, at 110 percent TGP, alevins had deformed gill covers, and some alevins lost equilibrium and floated as a result of burst air bladders releasing gas into the body cavity. The project will be reported in further detail during 1982.

Contact: John Jensen, Charles Lam,
Biologists, Fisheries
Research Branch, Pacific
Biological Station, Nanaimo.

Hydrostatic Pressure

Soft water (low in Ca^{+2}) may be associated with development of white spot disease, possibly through the influence of Ca^{+2} on water hardening and development of hydrostatic pressure in the egg. A method for measuring hydrostatic pressure in eggs, in order to examine these relationships, has been perfected. With the new information obtained, it also is now recognized that hydrostatic pressure influences oxygen delivery to the egg, and that it also may influence entry of chemotherapeutic agents into the egg during preventative disease treatment. The influence of soft water on egg development will be examined next. The technique for measuring hydrostatic pressure in eggs will be reported during 1982.

Contact: Dr. Don Alderdice, Program
Head, John Jensen, Biologist,
Fisheries Research Branch,
Pacific Biological Station,
Nanaimo.

Conuma Hatchery Monitoring Survey

Several studies were undertaken to learn why survival of chum salmon eggs collected by the Conuma hatchery from the Deserted River has been low and variable. Similar problems have been encountered with chum salmon eggs from Alaska to Oregon. Two projects on suspected components of the problem were undertaken at the West Vancouver and Nanaimo laboratories. At Conuma hatchery, the monitoring survey considered the holding environment for adult spawners, egg and sperm maturation and handling techniques. Preliminary results suggest that low viability of chum salmon gametes (eggs and sperm) was related mainly to the utilization of immature gametes. Further, the process of gonad maturation in ripening adults appears to be associated with freshwater exposure and to be retarded by holding ripening adults in sea water. Further results will be reported during 1982.

Contact: Charles Lam, Biologist,
Fisheries Research Branch,
Pacific Biological Station,
Nanaimo, and Dr. Joachim
Stoss, Research Scientist,
Fisheries Research Branch,
West Vancouver Laboratory.

Storage Time and Temperature

As a part of the investigation of low gamete viability at Conuma hatchery, the practice of storing gametes and transporting them from a remote collection site to a central hatchery prior to egg fertilization was examined. The influence of storage time and storage temperature on egg viability following gamete storage was also examined. Adult chum salmon from the Nanaimo River were transported to and held at the Pacific Biological Station, Nanaimo. There they were stripped and the gametes were stored at temperatures of 3°, 6°, 9°, 12° and 15°C for periods up to 370 hours. Crosses of stored gametes were made throughout the storage period, in addition to crosses of fresh (non-stored) controls, and crosses of fresh with stored gametes. In general, full gamete viability was retained longer at lower temperatures, while loss of viability occurred more rapidly in stored eggs than with stored milt. When both male and female gametes were stored, the number of hours of storage permitting 90 percent fertilization success varied as follows: 15°C--19.5 hours, 12°C--42.2 hours, 9°C--45.3 hours, 6°C--90.8 hours, 3°C--119.8 hours. Taking confidence limits (95 percent) into consideration, storage of chum gametes at or near 15°C should not exceed 12.5-13 hours. Major extensions of successful storage time can be attained at lower temperatures (e.g. ≤ 6°C). The influence of storage of Deserted River gametes on their subsequent viability is concluded to have been marginal (i.e. subsequent egg losses at Conuma hatchery are considered to have occurred as a result of factors other than storage time or temperature). Results will be reported during 1982.

Contact: Dr. Don Alderdice, Program
Head, John Jensen, Fisheries
Research Branch, Pacific
Biological Station, Nanaimo.

Coagulated Yolk Syndrome

Coagulated yolk syndrome (CYS), also known as white spot disease, is seen frequently among eggs and alevins in hatchery culture. Minor to major mortality may occur in affected egg lots. The cause of the problem remains unknown, but information on CYS is being gathered systematically in an attempt to identify factors associated with this longstanding problem. Two outbreaks of CYS with high mortality were reported in B.C. federal hatcheries during 1981. Both involved heavy loading of alevins in vertical tray stacks. In a preliminary trial (Puntledge hatchery) with low egg densities in Heath trays, with and without malachite green treatment, and in the presence or absence of tray substrate, no differences in incidence of CYS were noted. It was noted that alevins affected only to a minor degree with CYS can recover. Although no definitive information on CYS can be offered yet, a tentative recommendation would be to reduce tray loading density where CYS has been a problem. Hatchery managers interested in examining the problem in their facilities are urged to contact Charles Lam.

Contact: Charles Lam, Biologist,
Fisheries Research Branch,
Pacific Biological Station,
Nanaimo.

Keeper Channel Characteristics

Keeper channels, a component of the Japanese-style technique for chum salmon egg and alevin culture, are being used increasingly for other B.C. salmonids. Problems arising in the operation of keeper channels have led to the need to overcome uneven distribution of alevins in the channels, leading to loss through smothering; and to maximize production capacity of existing channels by modifying their design.

Observations to date suggest that upstream movement, crowding and smothering are due primarily to overloading the gravel with alevins. "Excess" alevins tend to move upstream. Loading density appears to be related directly to alevin size, which varies with species and with the usable void space in the substrate. A pilot study is being developed based on scaled-down models of a standard keeper channel. Channel characteristics considered for examination include water velocity, gradient, gravel particle size and depth, and alevin loading density.

Contact: Charles Lam, Biologist,
Fisheries Research Branch,
Pacific Biological Station,
Nanaimo, Bill McLean,
Operations Support Biologist,
Enhancement Operations.

Flush Treatment of Incubating Eggs

Flush treatment is a method commonly used in hatcheries to guard against development of fungus (e.g. *Saprolegnia*) in egg incubators. Malachite green, although a suspected carcinogen, remains one of the most effective chemical agents used in such treatments. Little information is available on the minimum effective dose of malachite green required to control fungus infection, or of possible sublethal effects of exposure to malachite green among treated eggs and resulting alevins. Initially, the dynamics of a flush treatment were examined in an eight-tray Heath stack, using malachite green as the test chemical. A quantitative test was developed first for estimating malachite green concentration in water; colorimetric measurement depends on pH control. In a typical flush treatment, exposure of eggs to malachite green (20 mL of 20 g/L stock solution; flow rate, 12 L/min.) varied between top (T) and bottom (B) trays as follows: total residence time--3 1/2 minutes (T), 9 min. (B); maximum concentration--25 mg/L (T), 8 mg/L (B); exposure time providing effective (> 3 mg/L) concentration for fungus control--2 min. (T), 4 min. (B); effective dosage--24 mg X min. (T), 20 mg X min. (B), indicating some loss of malachite green due to adsorption as it proceeds through the stack. Further work requires data on effective dosage for fungus control (concentration X contact time); data are currently unavailable. Results will be reported during 1982.

Contact: John Jensen, Biologist,
Fisheries Research Branch,
Pacific Biological Station,
Nanaimo.

Mechanical Shock

Salmonid eggs are sensitive to mechanical shock, and sensitivity varies with species and stage of embryonic development. As shock sensitivity has been difficult to measure, so has its potential influence on viability of eggs that are subject to manipulation or transport. A standard technique first was developed for measuring shock sensitivity. Initial tests of shock sensitivity in coho eggs were reported earlier. Further data now are available for coho and steelhead eggs. The two species tested show two important similarities: shock sensitivity begins to rise at fertilization (activation with addition of water) and there is no reduction during or following completion of water hardening (about 20 hours after activation); and maximum sensitivity occurs during gastrulation (before "eyeing"). Decline in shock sensitivity follows a similar pattern in the two species, beginning 11 (for steelhead) to 14 (for coho) days after fertilization (10°C). Maximum resistance to shock in both species is reached between days 18-20, and continues until hatching. However, the stage of development differs at which maximum resistance to shock is first achieved: in the coho it occurs at the "just-eyed" stage (beginning of eye pigmentation), and in the steelhead at the "well-eyed" stage (eyes fully pigmented; yolk 3/4 vascularized). In general, the data recommend the transportat·on of gametes, rather than newly dependence on and independence of rate fertilized eggs, and suggest that steelhead eggs not be shocked and picked until the eyes are fully pigmented. Results will be reported during 1982.

Contact: John Jensen, Biologist,
Fisheries Research Branch,
Pacific Biological Station,
Nanaimo.

Oxygen Requirements

Minimum oxygen levels for successful egg and alevin development are defined as those at which the rate of oxygen utilization is transitional between of oxygen supply. These "critical" levels are being determined in relation to temperature (3-15°C), water perfusion velocity (100-3,000 cm/hr.), pH (3.5-7.3), species, and stage of development from fertilization through hatching to the alevin swim-up stage. The results are intended to serve as basic criteria for all egg incubation and alevin culture conditions. Critical level series have been completed (fertilization to swim-up) for sockeye, chinook and pink salmon (at 5°, 10°C) and will be completed shortly for coho and chum (at 5°, 10°C) and steelhead (at 3-15°C). Rates of oxygen uptake of eggs increase about 100-fold between fertilization and hatching and about four-fold between hatching and "button-up." Ambient oxygen levels in the water supply required to sustain independent oxygen uptake (critical level) range from < 1 mg/L O_2 at fertilization to about 11 mg/L near hatching (at 10°C). Eggs exposed to lower oxygen supply levels (< 11 mg/L) a few days before hatching will hatch prematurely. After hatching, critical levels drop rapidly from about 11 mg/L to 7 mg/L O_2. Thereafter, there is a gradual decline to a critical level of about 3 mg/L O_2 at the button-up stage.

Contact: Dr. Peter Rombough,
Post-Doctoral Fellow,
Fisheries Research Branch,
Pacific Biological Station,
Nanaimo.

Hatchery Manual

A contracted study, completed in 1981, resulted in a "Report on evaluation of West Coast fish hatchery procedures and techniques for the purpose of optimizing smolt output for salmon enhancement." This report will be produced as a source book of information for skilled operators and as a training manual for students of hatchery technology. An advisory body is currently reviewing the report, which is expected to be published in late 1982.

Contact: Dr. Don Alderdice, Program
Head, Fisheries Research
Branch, Pacific Biological
Station, Nanaimo.

Chum Incubation Requirements

An experimental Japanese-style keeper pond incubation system was tested at Rosewall Creek using 1979 brood year chum salmon. Examined were the effects of egg/alevin density, flow rate, gravel depth, and increasing levels of metabolites on mortality, growth and developmental rates, and time and rate of emergence.

Japanese-style (feeding) versus box-style (deep-gravel incubation, non-feeding) culture techniques were evaluated for chum salmon at Rosewall Creek. Marked adults returning from three tests initiated with the 1976, '77 and '78 broods are currently being processed. Preliminary results indicate: the Japanese-style fish again are returning at a far greater rate than the box-style fish; the second test produced adults an order of magnitude better than the first and third tests; and the fish originally fed return at an earlier age than do the unfed. A preliminary report will be issued in mid-1982 when age analysis of the present returns is completed.

The natural homing/straying rate of chum salmon is being examined in a multiple-stream inlet. Chum fry were trapped in the Sucwoa River on their downstream migration to Tlupana Inlet (west coast of Vancouver Island) in April, 1981, marked by the removal of the adipose and one ventral fin, and released in the same river within 24 hours after capture. Recovery of marked fish from all inlet streams, on their return from the ocean, will determine accuracy of homing and identify both homing and non-homing individuals in the population for possible genetic analysis.

Contact: Rob Bams, Research Scientist,
Dennis Crabtree, General
Technician, Fisheries
Research Branch, Pacific
Biological Station, Nanaimo.

Salmon Genetics

Recent trends in salmon abundance, particularly in chum, chinook and coho, and increasing production of these species from enhancement technologies have greatly increased the need to understand the genetic mechanisms underlying geographic variation between salmon populations. Ultimately, these questions must be addressed: To what extent are separate spawning populations of a species genetically unique? How important is this uniqueness to long-term viability of the populations? Do hatcheries and other enhancement technologies influence the genetic composition of salmon stocks? What are the long-term implications of such influences?

Since 1980, researchers at the Pacific Biological Station have undertaken studies to address aspects of these questions. An annotated bibliography on salmonid genetics will be published in the spring of 1982. The bibliography includes 150 annotations in a total of 500 references written between 1920 and 1981. This bibliography will be published in the Technical Report Series in early 1982 and is available in computer-readable formats.

A study, begun in 1980, to assess the genetic variation between five chum populations in Tlupana Inlet and to investigate the impact of hatchery production on the genetic composition of Tlupana chum, is continuing.

Chum fry and adults from the five populations in Tlupana Inlet were collected during 1981. Fry were sampled in four of five natural spawning populations and all populations were maintained in the hatchery.

Preliminary results showed that genetic composition of these chum stocks and the consistency of genetic compositions between years was similar. Fry samples from natural and hatchery environments closely resembled adult gene frequencies, but tests on changes in gene frequencies between parents → fry → adults must await the returns of the 1980 brood year. If further experiments verify the apparent genetic similarity, management of these stocks could be simplified by treating the five spawning populations as one genetic population. This would simplify hatchery rearing practices and allow between-stream transplantation of fish to fully utilize natural rearing environment.

In 1982, the Genetics Unit will continue monitoring Tlupana Inlet chum genetics. The Unit also plans to initiate three more programs: a detailed study of the genetic structure of Upper Fraser River chinook stocks; a laboratory and controlled breeding study of the environmental and genetic factors affecting variation in coho; and an experiment to quantify interfamily competition when families are reared in a common environment (e.g. a raceway). The genetics program will also attempt to assist in identifying major salmon populations via electrophoresis.

Contact: Brian Riddell, Program Head,
Salmon Genetics, Fisheries
Research Branch, Pacific
Biological Station, Nanaimo.

Provincial Research

Genetics and Stock Identification

Two of the major problems in steelhead management are the lack of information on interceptions in the commercial fishery and the lack of data on racial structure of the species. Electrophoresis is a promising technique for attacking both of these problems because it can be used to examine differences between stocks, as well as variations within a stock. This technique uses enzymes present in the liver or muscle tissue to reveal differences between stocks. These differences, called electrophoretic variants, are genetically controlled, and are not influenced by environmental conditions. As such, they are "natural tags" which can be used to separate stocks in a commercial mixed fishery. The proportion of variants can be used to calculate the number of fish from each stock that has been caught in the mixed fishery.

Steelhead stocks on the south coast of British Columbia can be grouped into three major categories based on their time of return to fresh water: summer run, fall run or winter run. Summer- and winter-run fish are a mixture of stocks from a large number of coastal streams. Fall-run fish are from tributaries of the Fraser River upstream of Lytton; the Thompson and Chilko are the two main stocks. Because of the timing of their migration, fall-run fish are very susceptible to commercial interception; therefore, an accurate assessment of the commercial catch is an important aspect of the management of these stocks.

Two enzymes, LDH and SOD, were used to distinguish coastal winter- and summer-run fish from Interior fall-run fish. Another enzyme, AGP, was used to distinguish the Chilko stock from other Interior stocks. The numbers of steelhead intercepted in the three major south coast commercial fisheries are detailed below. The majority of fish intercepted are Interior fall-run fish. The commerciol catch of these fish is considerably greater than the sport catch, which is between 1,000 and 2,000 fish per year on the Thompson and 100 and 200 fish per year on the Chilko.

Estimated average numbers of steelhead intercepted in the major south coast fisheries during the 1978-80 period.

Stock	Johnstone	Juan de Fuca	Fraser	Total
Coast	2000	1100	0	3100
Chilko	800	500	100	1400
Thompson	200	3300	900	4400
Total	**3000**	**4900**	**1000**	**8900**

The analysis of the genetic structure of steelhead populations in southwestern B.C. is almost complete. Steelhead stocks are not genetically uniform over large areas; sometimes significant differences occur between adjacent drainages.

Genetic differences revealed by electrophoresis are not adaptive, but differences at an electrophoretic level indicate which stocks are genetically isolated and where the more difficult to measure adaptive differences should occur. This information is useful to management biologists who are considering transplants of either fry or smolts to rivers where wild production is important.

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Headwater Stocking

Steelhead smolts have been produced in hatcheries to augment wild steelhead populations. However, because of the high cost of hatchery production and the various effects hatchery fish may have on wild populations, SEP is now examining ways to enhance wild populations.

One potential method of enhancing wild steelhead stocks is by utilizing the rearing area above obstructions to adult passage. The objectives of this research program are to assess the biological and economical feasibility of stocking steelhead fry in headwater areas.

In 1981, the fourth year of this five-year project, two major experiments were conducted. The first experiment, in Lynn Creek, continued to examine the effects of racial origin and stocking density on growth and survival of fry and parr. The second experiment examined the effects of time of release and size at release on growth and survival in the Englishman River system.

To date, there is no consistent difference in the growth or survival between fish from native Lynn Creek brood stock and fish from foreign Big Qualicum brood stock. However, adult returns have not yet been examined. Other studies have shown major differences in return rates from foreign and native smolt releases.

Preliminary analysis indicates that growth and survival to 1+ parr are fairly constant at stocking densities up to 0.7 fry/m^2. A stocking density of 1.5 fry/m^2 produced much lower growth and survival rates to 1+ parr.

Replicate fry releases were done on the Englishman River and on its tributary, Moriarity Creek, at the following fry sizes and times in 1980: 0.2 g on July 4; one gram on Aug. 19; one gram on Sept. 8; two grams on Oct. 9; and six grams on Oct. 9. Sampling was done in the spring of 1981. The results indicate that in streams with no predators, such as the Englishman and Moriarity, there is little advantage in growing fish to one g for summer release, as the 0.2 g-fry had similar survival and growth rates. On the other hand, release of larger fry, either two gram or six gram in the fall resulted in larger 1+ parr with better survival, the following spring.

In 1982, a smolt trap will be operated on Lynn Creek to provide data on survival to smolt from fry stocked at three different densities and on the relative fry to smolt survival of Lynn and Qualicum fish. In addition, stream censuses using electroshocking equipment will be conducted on Englishman River, and Lynn and Moriarity Creeks. These will complete the field portion of this project, and the rest of the year will be spent in analyzing the data and preparing reports.

Contact: Jeremy Hume, Fisheries Biologist, Fish and Wildlife Branch, Vancouver.

Disease Diagnostics

Disease Background For Enhancement Populations

Steelhead and cutthroat trout enhancement sometimes requires the transportation of adults and/or eggs from one water system to another. The health status of the wild adults from the various river systems must be determined in order to reduce the risks of transferring and disseminating disease agents and jeopardizing the health of progeny. In cases where hatcheries are involved with rearing the progeny, the importation of a disease agent into the hatchery water supply could result in disastrous losses. Due to lack of disease information on steelhead and cutthroat native to various rivers, spawned adults from eastern Vancouver Island and on the Lower Mainland are examined for diseases.

In 1981, the Branch examined a total of 562 adult cutthroat, steelhead, chinook and brown trout from 34 river systems. The most prevalent disease agent detected was *Aeromonas salmonicida*, a bacterium responsible for the disease furunculosis. In 1981, this agent was found in nine different stocks, six being different from those found in 1980. Furunculosis has been implicated as the most important cause of some pre-spawning mortalities in steelhead. Design changes in holding pens have reduced the risks of transfer of this disease from one stock to another.

The bacterium which causes enteric redmouth disease (ERM), *Yersinia ruckerii*, was isolated from two new steelhead stocks in 1981.

Ceratomyxa shasta, a myxosporidian parasite, was found in cutthroat from the Fraser River; steelhead from the Coquihalla, Bonaparte and Silverhope Rivers; and chinook from the Bonaparte and Nicola Rivers.

The finding of the spores of *Ceratomyxa shasta* in B.C. has resulted in increased surveillance of the wild stocks for the presence of this parasite previously thought to be restricted in geographic distributions to the Columbia and Sacramento Rivers. The technique for detecting the spores is based upon the microscopic examination of a smear made from a portion of the lower intestine of the fish. Smears made on glass slides are air-dried and then stained with a dye to make any spores present readily visible under high magnification. The spores are recognizable by their characteristic shape and structure. A predetermined area of the smear is examined to ensure that lightly-infected samples are not missed.

In 1982, the Branch will continue to monitor spawning adults from enhanced river systems, using the most sensitive and up-to-date disease detection methods, including non-destructive sampling techniques.

The data collected in 1981, along with that from the two previous years, are helping to formulate a disease profile of the cutthroat and steelhead in the enhancement system. A pattern is emerging which indicates that most wild populations of steelhead and cutthroat are less diseased than previously thought. More study is needed in order to rule out year class variables. Eventually some runs may be declared disease-free or highly disease-resistant, and they will be very valuable as enhanced stocks.

Disease Prevention and Treatment in Cultured Stocks

Steelhead and cutthroat sub yearlings are being reared at various sites, including net pens in lakes, satellite hatcheries and earthen fish ponds. The diversity of environmental conditions represented by these rearing sites also presents opportunities for disease outbreaks, as has been evident in the past; 1981 proved to be no exception. During the year, there were several disease conditions which required identification and remedial action.

A major disease outbreak occurred again in 1981 in the fingerling steelhead in the net-pen operation at Cowichan Lake. At this site in July, 1980, there was a rapid increase in mortalities due to an external bacterial infection called Columnaris. The onset of the disease coincided with extremely high water temperatures (greater than 20°C) in the lake during mid-July to the end of August. In 1981, the net-pen operation was carefully monitored. As a precaution, the fingerlings were administered oxytetracycline, an antibiotic, in July. Columnaris did not appear until mid-August and the outbreak was less severe than that of the previous year. As in the past year, the parasitic protozoan Ichthyophthirius, or "Ich," appeared on the fish in the middle of August and caused sizeable mortalities which continued until the end of August.

Late in 1981, bacterial kidney disease (BKD) was detected in fingerling steelhead at the Loon Creek hatchery. Treatments were started in order to prevent high losses and in an attempt to eradicate the disease agent.

External gill parasites, as well as poor water quality, produced gill problems of varying degrees of severity in several off-site rearing facilities or earthen ponds. Therapeutic techniques, normally used to fight the parasites, were ineffective in these situations, due to the slow exchange rate of water or lack of flow in the systems.

Routine health checks were carried out on the stocks at the various off-site rearing facilities to monitor changes in health in relation to the varying environmental conditions.

As in the previous years, cutthroat trout were vaccinated against vibrio diseases prior to release.

Respiratory problems caused by the environment or by nutrition are often very subtle and may go undiagnosed when conventional autopsy techniques are used. For this reason, histological techniques are being routinely incorporated in health checks of stocks at rearing locations with marginal water quality.

The study on bacterial kidney disease (BKD) at the Loon Creek hatchery will continue in 1982. Mortalities will be checked daily for the disease agent, and the effectiveness of the drug treatments will be evaluated. A strict quarantine and disinfection program and an ongoing monitoring program for future stocks have to be established at the hatchery.

Major monitoring programs will also be required for the satellite hatcheries and other small off-site rearing ponds.

Extended use of net-pen rearing in lakes in 1982 may also bring about increased disease problems and therefore will require close attention.

Continuous disease diagnostic services are an essential part of the present fish culture program. Pinpointing the cause of problems is extremely valuable so that diseases can be prevented and production goals, with healthy fish, can be met.

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Keogh Pilot for Steelhead Enhancement

Research and development projects at the Keogh River on northern Vancouver Island were initiated in 1976/77 to: develop a model for estimating production capability of steelhead streams, assess the variation in the annual harvestable surplus for a typical coastal river, and finally, examine the feasibility constraints and cost effectiveness of several enhancement techniques.

Production and Residualism

Since 1976, production capacities and age-specific survival rates have been studied to aid in regulating annual harvest levels of fish stocks. A related purpose for the juvenile assessments after 1980 was to determine possible causes and magnitudes of "residuals" (i.e., cultured smolts, released into the lower end of the river, that fail to migrate to the ocean) and their possible impact on wild smolt production.

Wild Steelhead Production Capability

A preliminary model for predicting density of parr (age 1+, 2+ and 3+) and smolt yield from coastal streams was formulated based on parr density and relationship to habitat established for the Keogh River steelhead parr. The model was expanded in 1981 to incorporate stream water chemistry (total dissolved solids vs smolt yield), mean annual water temperature and smolt-to-adult survival. Initial testing indicated about a 30-percent over-estimation of smolt yield for another coastal river where estimates of physical habitat and yield were available.

Annual smolt yield in the Keogh River was found to vary more than expected; in 1981, smolt enumeration increased the five-year range for steelhead smolts from 2,100 to 10,000, which may limit the application of the production capability model. Results continue to indicate high annual variation in age-specific survival rates (particularly egg-to-fry and fry-to-yearling). The implication to fishery managers is: highly-variable harvestable surpluses of adults in coastal rivers where watersheds are managed both for timber and salmonid production.

This phase of the study is nearing completion. Collection of further data on survival rates includes wild smolt to adult for three years of smolt production. Final model testing, using two other streams, will be completed in the summer of 1982.

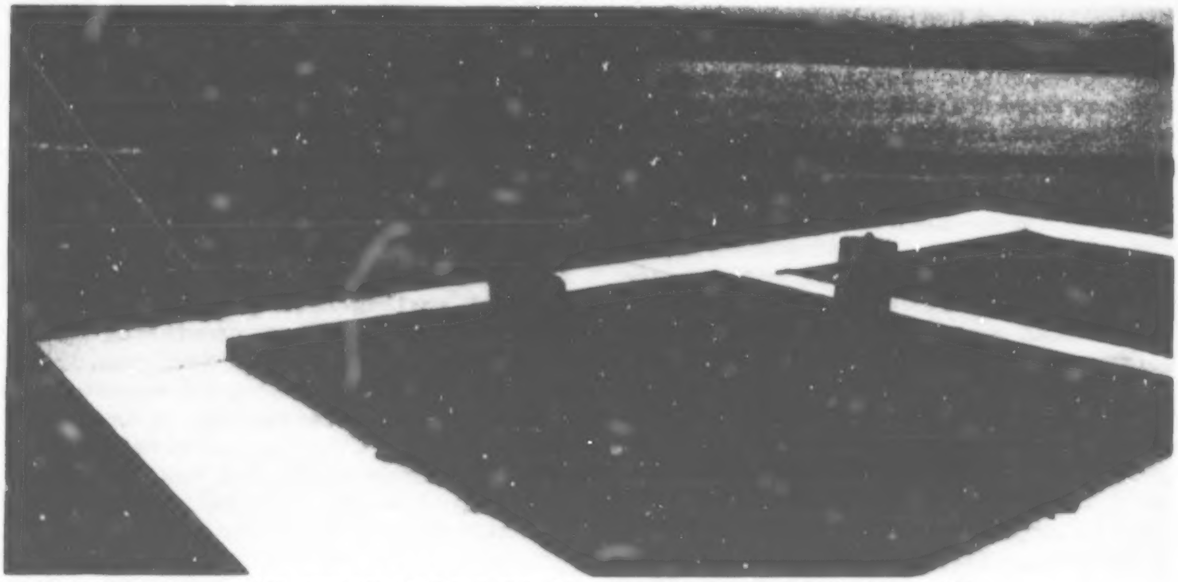
Residualism

Residualism (or failure to migrate) of net-cultured steelhead smolts was examined for two years in lower Keogh River to assess its significance in contributing to the typically low survival rates of cultured steelhead smolts on the Pacific coast. The percent of smolts failing to migrate from the Keogh River has ranged from seven percent to 32 percent. Most residuals do not become smolts in a second year, but rather become residents, most of which are males (i.e. male-female ratios 3:1). Densities of residual cultured smolts, found 2 km upstream and downstream of the stocking site, were equivalent to densities of wild smolts and were four times as abundant as the latter in standing crop. In 1981, 26 percent of the residuals had stayed through a second summer. While failure to migrate is a factor in the typically low rate of survival of cultured smolts to adult, a greater implication is that the carrying capacity of the stream is greatly exceeded by the residuals population. In smaller rivers that are managed for both wild and cultured stocks, stocking should therefore be restricted to the lowest reach.

Lake Pen Rearing of Steelhead Smolts

There have been few attempts to develop net-pen culture for salmonids in lakes. However, successful net-pen rearing would have advantages over more conventional hatchery culture--much lower capital costs, and possibly higher smolt quality, yielding improved benefits in returns of adults. Research and development of net-pen culture of steelhead smolts at O'Connor Lake in the Keogh system was designed to:

- determine if fish could be reared consistently greater than 45 g on average and preferably, greater than 60 g
- resolve operational problems, including high temperatures, freezing and predation



FWB staff survey the fry-holding pens for steelhead at Cowichan Lake.

- determine effects of rearing density on juvenile growth, smolt quality and returns of adults
- assess survival to release for various groups of smolts, stocked at various locations.

During 1981 (the third year of the O'Connor Lake operation), 18,000 large smolts (63 - 105 g, winter run) were released into the Keogh River. An additional 5,000 undersized smolts were released into a neighboring small stream, Mills Creek, at Port McNeill. In 1982, 31,000 smolts (weighing 70-80 g each) are projected for experimental releases (variable locations) in mid-May into the Keogh River. Also, 5,000 parr will be released into a closed lake. In addition, a pilot group of approximately 12,000 Tsitika stock summer steelhead, which were successfully reared, will be transplanted to the Campbell River, to establish a summer steelhead fishery.

Planned production in 1982 is for 40,000 Keogh winter run smolts to be stocked at different sites in the Keogh River, and 30,000 Tsitika summer steelhead smolts stocked into Campbell River.

Growth at higher loadings and densities in 1981 were less than in 1979 and 1980, providing further evidence of density-dependent effects on smolt quality, particularly in terms of fin erosion and possibly greater variance in size.

Stream Enrichment

Research that was conducted in 1980 to assess the benefits and constraints of stream enrichment as an enhancement technique also identified the need to measure food chain responses to enrichment of a stream, the upper Keogh River, rather than in small troughs as was done in 1980. As a result, three main questions were posed as essential to the development to stream enrichment as a possible salmonid enhancement technique, and to increase understanding of food chain relations in streams in general:

- at arbitrary levels of both organic (cereal grain, for example) and inorganic (fertilizer) enrichment over the short term, what is the relative magnitude of response by periphyton (stream bottom algae and bacteria which insects use for food), stream insects (fish food organisms), and fish?
- if enrichment does increase food

chain activity (relative biomass increases per unit of time), what is the minimum amount of enrichment material, and in what form is it required, to increase fish food standing crop to an optimum level?

- what is the real long-term fish response in terms of relative change in juvenile survival and growth rates over several years, smolting age, smolt yield and eventually adult returns, including cost effectiveness?

Studies during 1981 specifically dealt with the first of these questions: to assess changes in periphyton, stream insects and anadromous fish biomass and growth rates as they related to grain and fertilizer additions. All work was conducted in the Keogh River, on northern Vancouver Island, from April through September.

The experimental design included four 200-metre sections, each having similar flow and habitat conditions within a 2-km reach of the upper river. The sections were separated by 200 m zones in which no treatments were applied. From upstream to downstream the sections were: (1) control, (2) organic matter treatment (crushed barley), (3) low-level fertilizer addition (NH_4NO_3, and NH_4HPO_4, N/P + 10/1 by weight) to achieve a 10 µλ nitrogen and phosphorus increase over ambient concentrations, and (4) higher-level fertilizer addition to achieve a 20 µλ nitrogen and phosphorus increase over ambient concentrations. Relevant pretreatment data were available from control and treatment sections since 1977.

Periphyton net colonization rates (total accumulation on the stream substrate minus losses due to sloughing and grazing), biomass and community composition (algal genera) did not change with barley additions. Fertilizer additions, however, resulted in an increase in colonization rates to 19 mg chlorophyll "a"/square metre/day over control levels of 0.5 mg chlorophyll "a"/square metre/day within the first month of treatment (May-June). Cell volumes were dominated by diatoms. Increased sloughing and decomposition were coincident with declining stream flows in July, particularly in fertilizer-treated sections where a large biomass had accumulated. Rapid recolonization after sloughing did not occur, despite continuous enrichment. Unicellular green algae dominated during this low-flow period. With the onset of higher flows in September, differences in colonization rates and biomass between fertilized and control sections reappeared and diatoms again dominated.

Stream insect abundance was very low (approximately 1.5 g/m^2 wet weight) at the time treatments began, reflecting the low point in standing crop due to adult insect emergence. Control levels remained low for the duration of the summer. By September, however, invertebrate biomass increased to a peak of 4.0 and 9.5 g/m^2 wet weight with barley and fertilized treatments, respectively. A mid-summer decline in insect biomass was not apparent.

After two-and-a-half months of fertilizer additions, weight of underyearling steelhead, coho and Dolly Varden char doubled, and weight of steelhead parr increased by about 50 percent over the control. Standing crops (g/m^2) also increased two-fold, corresponding to improved growth. There was no significant change in densities. Sampling of juvenile coho in autumn indicated a less marked effect of enrichment in the second two-and-a-half-month period, coincident with low flow and a collapse in periphyton populations during midsummer.

Organic enrichment, in contrast, had little effect on growth, standing crop, and density of juvenile salmonids during the first period. However, samples collected in autumn indicated that the mean weight of coho fry was 60 percent greater than that of the control, although it was smaller than for coho in the inorganic treatments.

The results show that stream enrichment might be a viable enhancement option, but further intensive research relating to the two other questions noted earlier is required to fully develop the technique. In 1982, experiments will be conducted to evaluate relationships in the food chain activities, and a slow-release fertilizer will be developed and tested in preparation for a large scale application in 1983.

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Program Development and Bio-economic Evaluation

Program Development Branch

Within SEP, the Program Development Branch advises on policy and program direction to ensure that the program maximizes the social and economic benefits arising from salmonid enhancement. In particular, the Federal/Provincial Agreement, signed on March 1, 1979, commits the governments of Canada and British Columbia to work toward:

- augmenting national and provincial income
- creating employment opportunities for Canadians
- improving the economic opportunities for native Indian people, consistent with the need to preserve their social and cultural heritage
- fostering the development of economically-disadvantaged communities or regions
- increasing and improving resource and environmental opportunities.

This responsibility entails a planning function to:

- establish enhancement production targets
- evaluate the comparative merits of alternative enhancement/management strategies
- develop project options to meet the desired targets
- evaluate the merits of selected projects before and after implementation.

The Branch is also responsible for the assessment of program components and the program as a whole to facilitate decision-making for the future of the Salmonid Enhancement Program.

All major SEP project proposals are evaluated on the basis of four criteria: technical feasibility, manageability, enhanceability and desirability.

Opportunities for enhancement are identified, and management plans are reviewed to ensure that the catches of enhanced and unenhanced fish from particular watersheds can be optimized. When project proposals are determined to be "manageable," the project is evaluated from an economic standpoint to determine its desirability.

In 1981, these tasks assumed new proportions, as planning activities for Phase II of SEP received top priority. When signed, the Salmon Interception Agreement with the United States will add a new dimension to the planning activities, as such an agreement could substantially alter Phase II in terms of its regional focus, its species mix and its overall cost. An interception agreement would permit SEP to place more emphasis on the Fraser River and on sockeye production, which could achieve a given production target at less cost.

With Phase II planning underway, SEP Phase I and individual projects come under close scrutiny. The Community Economic Development Program component of SEP was subjected to detailed evaluation, and ex post analyses were undertaken for the Capilano hatchery and Meziadin fishway.

The activities undertaken by the Branch in 1981 have been separated into three component sections along professional lines, to simplify the complex program structure. However, it should be recognized that all three components are closely integrated.

Contact: Harold Swan,
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Program Development.

Biology

Biologists from the Program Development Branch served as the major vehicle for transmission of SEP proposals to the Geographic Working Groups (GWGs), which are comprised primarily of the fisheries management components of the Department and the provincial Fish and Wildlife Branch. The GWGs examine SEP proposals, and their decisions and recommendations are transmitted back to SEP's management committee.

In 1981, a special effort was made to ascertain whether or not habitat conditions had become an impediment to success of SEP programs. Program development biologists also made very substantial contributions to the identification of enhancement opportunities for Phase II of the program and to ongoing U.S.-Canada salmon interception negotiations. SEP's involvement in the evaluation of the concept of cooperative watershed management continued in 1981.

In addition to these activities, the Branch also sponsored a predation study on the Big Qualicum River hatchery production and initiated steps to expand the program evaluation component.

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Development Branch.

Habitat Evaluation Exercise

SEP planning biologists, in association with the Habitat Management representatives on the GWG, undertook to interview all the district fishery officers to establish the current habitat conditions in each of their areas. Flow control, forestry, urbanization, industrial development, and where appropriate, estuary development, were examined. The degree of impact was projected, the character of the impact was defined, as were the areas and species affected. A prediction of trends in each major category was made. Finally, each officer was asked to suggest a course of action to deal with these trends. Included in the choices were large scale enhancement, small scale enhancement, fishery management regulation, habitat management, habitat protection enforcement, or any combination thereof. This information was collated and summarized for each of the three fisheries management regions in the province.

The purpose of the habitat evaluation exercise was to identify current habitat problems which were affecting the overall production throughout the Region, to establish future trends and identify possible interactions between the fisheries management, enhancement and habitat management which are impacting or could potentially impact on the Salmonid Enhancement Program. To these ends, the exercise was a success. Three basic themes emerged insofar as SEP is concerned. First, there was the strongly-held view that industry should be encouraged to participate in SEP on a much wider scale. This participation would be in the form of compensatory enhancement, designed to offset those losses which occur subtly over a long time, despite the best habitat management efforts. Secondly, there were a substantial number of habitat restoration opportunities identified, although these will require careful scrutiny to make sure that SEP does not undertake any activity which should more properly be conducted by the perpetrators of the habitat degradation. Finally, there was a recognition that in certain instances, SEP projects could not proceed without a resolution of, or the identification of a process for resolution of, certain habitat protection issues. For example, the expansion of Alcan's hydroelectric project precludes the development of SEP projects on the Kemano and Nechako Rivers. In the absence of a federally- and provincially-enforced water management plan on the Nicola River, the development of a SEP facility on that river involves acceptance of considerable risk. The restoration of the once significant Bridge River chinook and coho populations is dependent upon B.C. Hydro's release of a modest amount of flow into that river system.

It was also apparent that the fisheries resource could be threatened by shortage of water precipitated by the population growth over the next 20 years on the east coast of Vancouver Island. With proper planning, DFO could avert this threat by incorporating enhancement technology into water storage projects.

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Graham, Biologists, Program
Development Branch.

Enhancement Opportunities for Phase II

In 1981, as part of the planning for Phase II, opportunities for enhancement were identified, using existing Departmental records and from information provided by fishery officers. The information obtained from these two sources was tabulated and collated into a basic source document for use by the Enhancement Opportunities Subcommittee. Upon completion of the Enhancement Opportunities Subcommittee's report, the manageability of the opportunities identified will be evaluated by the GWGs.

Contact: Bill Schouwenburg, Bud
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Development Branch.

Big Qualicum River Predation Study

In 1981, the Program Development Branch funded a study on the effects of Bonaparte's gulls' predation on juvenile salmon produced from the Big Qualicum River hatchery. Studies (for a doctoral thesis) conducted in 1979 and 1980 seemed to indicate that Bonaparte's gulls were very substantial predators on juvenile chinook salmon released from the hatchery. Therefore, a 1981 study was conducted for the broad purpose of determining the impact of bird predation, particularly that by Bonaparte's gulls on juvenile coho and chinook salmon in the Big Qualicum estuary and to determine the most effective ways of lessening this impact. More specifically, the study was to:

- estimate juvenile salmon densities and resident times throughout the period of their downstream migration
- determine a numerical response of fish-eating birds in the Big Qualicum estuary to the densities of juvenile salmonids
- determine the feeding response of gulls in the Qualicum estuary as it relates to the density of juvenile salmonids
- determine the actual numbers of juvenile coho and chinook salmon taken by bird predators in the Big Qualicum in 1979, 1980 and 1981 (These were estimated from the feeding observations and from data from the literature on body weights, consumption rates and composition of the diet of the bird.)
- gain general insights into the problem of predation in fisheries and the necessity for more comprehensive study on the problem.

Although the 1981 obervations were complicated by the fact that many blind fish (due to problems in food deficiency) were released from the Qualicum hatchery, some very significant conclusions were drawn from the results from the analysis of the three years of data:

- The numbers of fish-eating birds present in the Big Qualicum estuary were affected by: coho abundance, chinook abundance, time of season, time of day and tidal height.

- In 1979 and 1980, it was estimated that approximately 300,000 juvenile chinook (i.e. 12 percent of the total migration) were taken by major bird predators in the Qualicum River. Bonaparte's gulls account for the majority of this predation. In 1981, approximately one million juvenile chinook salmon, or 25 percent of the release, were taken by the major bird predators. Bonaparte's gulls did not take significantly more chinook than in other years and were not the major predators in this circumstance. Most of the chinook were taken by glaucous-winged gulls.
- Bonaparte's gulls were most responsive to the presence of juvenile salmon, particularly chinook. Up to 1,700 Bonaparte's gulls responded to chinook releases in 1981. Other birds did not appear in large numbers when chinook were released in 1979 and 1980, but in 1981, glaucouswinged gulls, Arctic loons, and harlequin ducks all keyed into the chinook releases. Mergansers and scoters were also observed capturing chinook fingerlings in that year. The exaggerated response of the birds to the chinook releases in 1981 was due to two factors: a nutrient deficiency which severely impaired the fishes' vision (making them easy prey), and an earlier timing of the releases. The chinook were released in mid-May when some migratory species, such as Arctic loons and mergansers, are present. Approximately 2,340 fish-eating birds were recorded in a single count on the Big Qualicum estuary in 1981.
- Bonaparte's gulls were able to feed effectively on healthy juvenile chinook and coho only at tides below three metres or in water depths of less than 80 centimeters. The gulls fed continuously from dawn to dusk on partially-blind chinook; in this case, the height of the tide did not affect feeding rates.
- Glaucous-winged gulls, harlequin ducks and scoters fed extensively on chinook fingerlings in 1981, but not in the two previous years. Arctic loons and mergansers fed on chinook in all years.
- Bonaparte's gulls were found to be extremely efficient predators on hatchery-reared juvenile chinook salmon; up to 93 percent of their strike attempts resulted in successful captures of chinook; up to 33 percent of attempts on coho smolts were successful.
- In 1981, flocks of Bonaparte's gulls destroyed up to 545 chinook in each five-minute period, compared with 152 in 1980. By comparison, Bonaparte's gulls ingest a maximum of 63 coho smolts in each five-minute period.

Predation effectiveness is a very site-specific factor--a brief survey of predation in the Capilano estuary indicated that it was not significant there. It was also observed that the effectiveness of bird predators can be altered by changing the times of release to coincide with favourable tides. It is also apparent that physical means of controlling the access of predators to the released fish can be implemented on a site-specific basis, all of which suggests that each SEP hatchery facility should be examined to ascertain whether or not it has a problem with avian predators.

A technical report on the results of this study will be published in 1982.

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Development Branch.

Cooperative Watershed Management Studies

In 1981, SEP continued to demonstrate its interest in the concept of cooperative watershed management. Consultants were assigned the implementation project which would incorporate the protection of fish and fish habitats into an official community plan, municipal guidelines for development,

A cooperative watershed management approach has been tried on a pilot basis on the Salmon River near Langley.

local and regional park development, water licencing and private agricultural activities. The pilot project, carried out on the Salmon River in Langley, would also educate the public of the need for a cooperative watershed management approach involving stream rehabilitation and maintenance and the establishment of fish stocks and production goals. The results of this implementation project were published in the report entitled "The Implementation of a Co-operative Watershed Planning and Management Program for the Salmon River Watershed, Langley, B.C." The principal conclusions contained in this report are:

- The Salmon River contributes 12,300 coho to the Georgia Strait sport and commercial fish catches. These fish have a total value of $327,000 in 1978 dollars. A modest public involvement project using voluntary labor was able to virtually eliminate smolt mortality from the Salmon River drainage pumps in spring, 1981. It was determined that the existing catch could be doubled if overwintering habitat was increased. This would have a potential production value of $784,800 in 1978 dollars.
- Both streamside property owners and other community residents wish to see the maintenance of the stream quality consistent with high salmonid production. There was also a high public perception of the need for cooperative watershed management. This reinforced the conclusion from the 1980 report, which stated that maintenance of stream quality, consistent with the resident property values, could ensure the future of fish habitat.
- The most effective institutional mechanism to ensure good land use planning in the interest of fish in watersheds (such as the Salmon River) is the Municipal Planning Act. Cooperation with municipal officials at the planning level is superior to the reactive approach taken through the referral process, which is triggered by individual property development proposals. There appears to be a good reason for separating planning functions from the conventional habitat protection function, because cooperative watershed management demands a broader understanding of the links between habitat, production potential, stock strength and fish use.
- The project has demonstrated the potential and value of maintenance of natural wild stocks in small streams.
- Much of the information at the biological, geographical, and social science levels can be extrapolated to watersheds with similar physical conditions, resource uses, and current use patterns. There may be little need for the development of new bureaucracies, but rather a need to learn how to use the existing systems better.
- In terms of cost, safeguarding existing stocks and the possible doubling, range from a realistic 20¢ per adult fish caught to a high of 80¢ per adult fish caught; this compares favorably with the range of 25¢ to 74¢ per adult produced from low technology production facilities, and with $2.75 and a $1.79 for adult fish produced by Capilano and Quinsam hatcheries, respectively.

The project stopped short of full community involvement and even total interagency involvement because senior governments first had to endorse the concept of cooperative watershed management. The Salmon River and Langley project have now reached the point where a decision must be made by senior government on how it wishes to proceed with the application of the concept.

On the basis of these conclusions, the consultant recommended that DFO and the B.C. Fish and Wildlife Branch gradually move from a referral-dependent reactive approach to habitat management to a cooperative watershed management approach. This would involve the extension of the Salmon River program to Langley municipality, the whole of the lower Fraser Valley and eventually to other fisheries management areas in the province.

Contact: Bill Schouwenburg, Senior
Biologist, Program
Development Branch.

Canada-U.S. Negotiations on Salmon Interception

Considerable progress toward an international salmon agreement has been made between Canada and the United States. Such an agreement will have important implications on future management and enhancement plans in B.C. Although 1981 did not bring a finalization to an overall agreement, interim arrangements were negotiated for conservation of Pacific salmon for 1981 and 1982. This represented an important step towards the resolution of a number of issues which have proved contentious in the past. In this arrangement, the government of Canada and the governments of Alaska, Washington and Oregon would impose certain conservation measures on key intercepting fisheries in both countries, as well as establish cooperatively an important salmon tagging program in the northern B.C. - southeast Alaska area, and set a one year timetable for the development of a longer term agreement.

In addition, further study of international interceptions has been undertaken, with specific attention to the sport and commercial balances between the two countries. The valuation of these interception balances has been examined in detail so that the economic implications of an international agreement will be fully understood.

Contact: Bud Graham, Biologist,
Program Development Branch.

Economics

Project and Program Analysis

All SEP projects, programs and policies are evaluated on the basis of their contributions to each one of the five accounts established to reflect the objectives of the program--national income, three distributive accounts (namely, employment, native people, regional development), and resource and environmental preservation. Methodologies for each have been established and were used successfully in 1981 in all evaluations. The evaluations were used by decision-makers to assist them in planning a balanced Salmonid Enhancement Program. In 1981, SEP economists:

- assessed the entire first phase of the program (for submission to the Pearse Commission on Pacific Fisheries Policy)
- evaluated the Community Economic Development Program
- carried out a study of resource use interaction
- completed the expost analyses of the pre-SEP facilities at Capilano hatchery and Meziadin fishway
- continued to assess the cost recovery aspects of the recreational fishery and various international negotiation strategies.

Contact: Steven Wright, Evaluation
Economist, Program
Development Branch.

Program Analysis

A detailed program evaluation was performed on the entire first phase of SEP for use in a submission to the Pearse Commission on Pacific Fisheries Policy and for presentations to the Salmonid Enhancement Task Group and the SEP Board. Actual costs and expected adult production were incorporated for the past four years of the program, and estimates were used for 1981/82 through 1983/84.

Two program options for the balance of Phase I were considered. The first option included the construction of the Glendale spawning channel. The analysis of this option indicated a total Phase I production capacity of 31.5 million pounds of salmonids with a benefit/cost ratio (for the whole Program) of about 1.2:1.0. Regional, environmental and resource arrangement impacts would equal or exceed 1980 projections, whereas employment and native people benefits would fall short of earlier projections. The second option involved deferring Glendale and reallocating these funds towards increased lake enrichment and other facilities. This scenario results in a projected salmonid production capacity, by the end of Phase I, of approximately 39.7 million pounds with a benefit/cost ratio (for the whole Program) of about 1.3:1.0. Environmental and resource management impacts would equal 1980 projections, whereas the employment, regional and native people impacts would be less than these original projections.

With the current level of funding, it is projected that SEP will not be able to achieve its Phase I production target of 50 million pounds. This could be achieved, however, if funds were forthcoming to compensate for inflation and the extension of the program from five to seven years. In fact, the Program has been spending funds more efficiently in terms of fish production capacity than was originally projected.

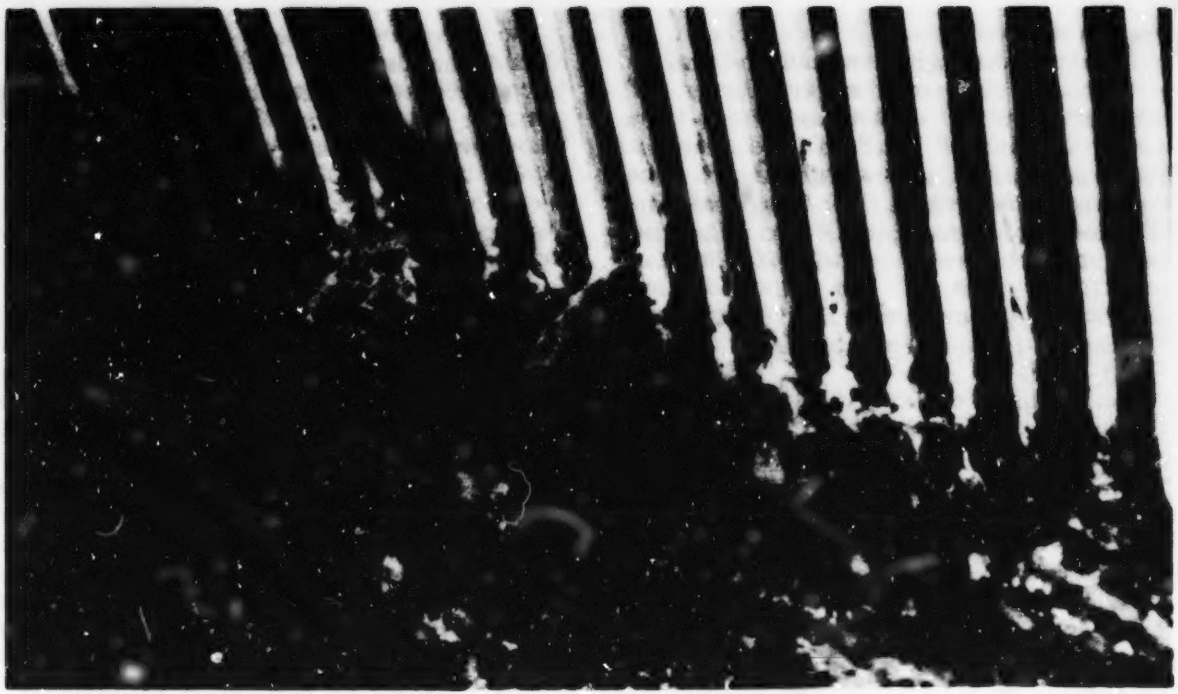
An assessment of the Community Economic Development Program was undertaken by a consultant in 1981. The purpose of the study was to determine the technical success and economic viability of the CEDP program and to evaluate the social benefits realized in the communities involved. The report should be published and available early in 1982.

Plans for an expansion of the CEDP were undertaken with the involvement of SEP and personnel from the Department of Indian and Northern Affairs and the Native Brotherhood of B.C. This expansion effort was prompted by the success of the program in meeting the aspirations of the native communities where projects have been established and by the extensive interest shown by other native communities in B.C. These efforts are continuing.

Contact: Steven Wright, Evaluation
Economist, Program
Development Branch.

Project Assessments

Expost analyses using the five account framework were applied to evaluate two facilities which were in existence before SEP. Actual cost and production information and more specific standards for future estimates were incorporated. Results show that Capilano hatchery achieved a benefit/cost ratio of 1.2:1 in the national income account. The employment account could not be evaluated because of the lack of unemployment data for the construction industry. The regional development account rating was poor, because the harvesting and processing of fish produced occurs primarily in the well-developed Georgia Strait and Lower Mainland region. The native people account rating was fair because of improved native food fishing benefits. A good ranking is attained in the resource and environmental preservation account, primarily because environmentally-threatened coho and steelhead stocks have



The Economic Branch scrutinized the benefits of the Meziadin fishway to migrating sockeye spawners.

been restored, and the project has exceptionally good educational aspects.

The second pre-SEP project which was subjected to scrutiny was the Meziadin fishway, which was completed in 1966. The decision to proceed with fishway construction was made on the basis that substantial mortalities to migrating sockeye salmon spawners were occurring in some years at Meziadin Falls. On the basis of biological survey data in 1957, 1958 and 1959, these mortalities were estimated at 38, 4 and 45 percent respectively. In the absence of further data or corroborative flow records in years other than those studies, it was not possible to establish an acceptable annual mortality rate for sockeye migrating to their spawning grounds in the Meziadin River drainage. Consequently, it was only possible to calculate a range of benefit/cost ratios on the basis of the two extremes of observed mortalities. The benefit/cost ratios for the national income account were calculated to vary between 0.18:1 and 1.08:1, using the currently-recommended discount rate of 10 percent. The regional development account ranking was good, while the native people and resource and environmental preservation account rankings were fair. The employment account could not be evaluated because of lack of unemployment data for the construction industry. Published reports on this and the Capilano analyses are available upon request.

The analysis of the benefits accruing from the Meziadin fishway demonstrates the need for caution when deciding to improve obstructions which are barriers to fish migration only part of the time. It also demonstrates the importance of obtaining several years of biological data and several years of corroborative flow records in evaluating the merits of correcting such partial barriers.

Contact: Kris Lam, Research Assistant,
Program Development Branch.

Resource Interactions

The issue of interaction among resources promises to become more prevalent as the B.C. economy continues to expand and the province's natural resources are exploited. In order to provide a framework within which to assess these interactions, studies of fish-forest interactions have been undertaken--on a conceptual level, and in a case study of the Toquart watershed on the west coast of Vancouver Island. It is intended to expand these studies to other resource uses (urban development, hydropower, agriculture) so that greater understanding is developed of the costs and benefits of SEP activities on other resource users and, likewise, of their impact on SEP. Ultimately, these benefits and costs would be included in the national income account.

Contact: Steven Wright, Evaluation Economist, Susan Steele, Planning Biologist, Program Development Branch.

Policy Analyses

a) Recreational Fisheries Issues

A report entitled "Employment and Income Directly Associated with Sport Fishing in B.C." was completed and submitted to the Department. The principal objective of this report is to estimate employment and income coefficients associated with angler expenditures. These coefficients will eventually be used with the estimates of gross angler expenditures, which are currently being compiled from the 1980 national sport fishing survey data, to determine total employment and personal income supported by resident angler gross expenditures in B.C. A final report containing these overall estimates is expected to be completed by mid-1982.

A survey of hatchery visitors was conducted at the Quinsam, Puntledge, Big Qualicum and Capilano hatcheries during the summer of 1981. The purpose of this survey was twofold--first, to evaluate and test automatic visitor counting devices and secondly, to determine attitudes, use and expectations of visitors to these hatcheries. Results of this survey will be available in 1982.

Contact: Pat Loftus, Research Assistant, Program Development Branch.

b) Cost Recovery

Tidal water sport fishing licences were introduced in B.C. by the Department in 1981. Returns up to April 1, 1982, indicate that more than 281,868 licences were sold to residents and non-residents during that year.

Table 24

Sales and Revenue of B.C. Tidal Water Sport Fishing Licences 1981*

	Sales	Revenue
Resident Annual	227,835	$1,136,098.00
Non-Resident Annual	19,330	386,600.00
Non-Resident 3-day	12,794	127,940.00
Res/Non-Resident 1-day	25,909	76,681.50
	281,868	$1,727,319.50

*Based on returns of licence sales receipts of 610 of 631 vendors by April 1, 1982.

Implementation costs for this first year are estimated at $758,900. Net revenue of more than $968,419.50 from these licence sales will be credited as the recreational contribution toward expenditure incurred during Phase I of the SEP.

Contact: Pat Loftus, Research Assistant, Program Development Branch.

c) Canada-U.S.A. Salmon Interception Negotiations

An international salmon agreement between Canada and the United States could open the way to future enhancement of stocks significantly affected by international fisheries. Further study of international interceptions has been undertaken with specific attention to the sport and commercial balances between the two countries. The valuation of these interception balances has been examined so that the economic implications of an international agreement will be fully understood.

Contact: Heather Fletcher, Economics
Advisor, Program Development
Branch.

Systems Component

The Systems group has been functioning for one year, providing computer services and statistical expertise to SEP. As well as providing technical assistance, this unit has been involved in the administration of computer services.

One of the major activities during the past year was assuming responsibility for administration and operations of EPIC, the Salmonid Enhancement Project data base. There has also been considerable involvement in the development of PRUNES, CISFIN, the proposed salmonid escapement data base and use of Apple micro-computers.

Another major activity is an involvement in the Fisheries Statistics Committee. This committee is currently reviewing all of DFO's information systems, working towards specifications and implementation of revised sytems where necessary. One of the goals of this committee is to develop an integrated fisheries statistics system.

Contact: Rosemary Pogue, Systems
Coordinator, Program
Development Branch.

EPIC Data Base

During 1981, EPIC was utilized extensively in program planning and evaluation exercises. The integration with the production model analysis programs became fully operational. Use of the data base's report-writer feature, to generate the "detailed project evaluation listings" required for the Salmonid Enhancement Task Group and SEP Board presentations, was a time-saving application of the EPIC---production model interface.

Twelve pre-formatted data reports are now available through a simple access procedure. Several of these have been used to streamline budget planning and project information update processes. One report in particular was designed as a project summary to be distributed in booklet form. Initial production of the project review booklet was coordinated with collection and input of extensive project base information. The second edition of the booklet, containing the accumulated project base information, the 1981 budget plans, production targets, and five account analyses from the 1981 program evaluation, was printed for distribution to the SEP Board, providing them with a comprehensive reference source on SEP projects.

Although EPIC is already heavily utilized, it is still in a developmental stage. In the future, EPIC will contain program review data on actual expenditures, juvenile releases and utilization of adult returns.

Contact: Rosemary Pogue, Systems
Coordinator, Program
Development Branch.

Salmonid Escapement Data

The project is underway to automate storing historical salmonid escapement data. When completed, the system will give easy on-line access to escapement information.

The user requirements were developed by a consultant, in conjunction with personnel in the various branches. This document has been reviewed, modified and approved by the users.

The development and operating costs were analyzed, and it was decided to locate the system at a service bureau instead of buying an in-house minicomputer.

The next phase of the project, system design, is about to begin.

Contact: Sharon Henderson, Chief,
Computer Services.

Microcomputers

SEP makes extensive use of microcomputers in its day-to-day operation. The Apple II Plus computer is the model most widely used by SEP personnel. This system is now in use at hatcheries and spawning channels throughout the province. Using the Apple computer, hatchery personnel can carry out the numerous calculations required for the efficient operation of the facility in a fraction of the time required previously. This allows more time for other duties.

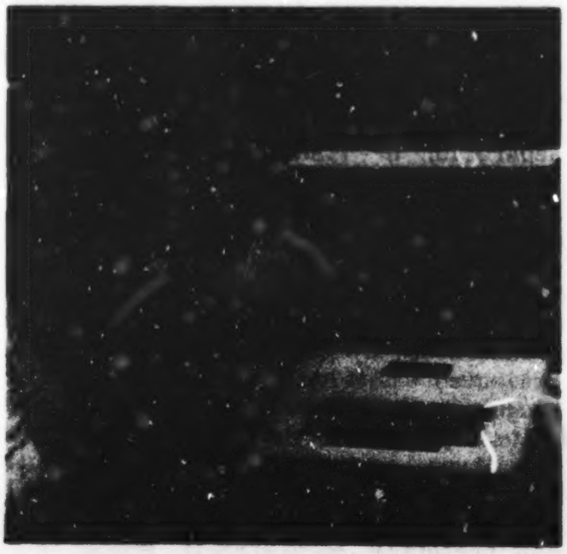
Due to the standardization of data collection brought about by the Apple computers, analysis of the information becomes easier for fisheries biologists. Enhancement techniques are constantly being adjusted and the improvement in data collection should help in the search for better means of producing fish.

Apple computers are used at Regional headquarters in a number of roles. Modelling of the effects of proposed management and enhancement strategies is a common use. The Skeena River fishery management model was introduced in 1980 and is currently being used as an aid to pre-season and in-season management of the Skeena River fishery. More complex models have been developed to show the effects of changes to the Georgia Strait fishery, and the fishery for the entire B.C. coast. The effects of various management and enhancement strategies for Fraser River chum and chinook have also been modelled using the Apple computer. Currently, a model to show the effects of changes to the Johnstone Strait pink and chum fisheries is being developed.

Apple computers have also been used extensively in support of international negotiations with the United States. Other uses of the Apple include budget management, data storage for salmonid life history information, head recovery program data storage, and word processing.

New uses for the Apple micro-computers are being found almost daily. One of the areas in which these computers will become more widely used is graphics. The Apple has great versatility in graphics input and output and these machines can be used for chart production, graph plotting and map analysis.

To coordinate the use of the Apple computers, the Apple User's Group was reactivated in 1981. It serves as an



The Apple microcomputers take a big bite out of the paperwork required for data collection.

information source for Apple users, and it provides direction for the development of Apple use within the Department.

To facilitate greater use of Apple computers, the Sytstems Group has offered training courses in basic programming and general maintenance of the Apple. Interest in these courses has been high, and the results have been positive. Use of these computers will increase as more people become familiar with them.

Contact: Gordon McIntyre, Planning Biologist, Heather Fletcher, Economics Advisor, Program Development Branch.

The Pacific Region U.S.-Canada Negotiating Systems (PRUNES)

The Pacific Region U.S.-Canada Negotiating System (PRUNES), in operation since 1979, comprises a 10-year catch base (for 1971-1980) for all fisheries on the Pacific coast, from Alaska to California, inclusive.

The system contains information on annual commercial and sport catches for each statistical fishing area, annual landed and wholesale prices, and coastwide average weights for chinook, coho, chum, pink, sockeye and steelhead. Programs have been written to permit separation of fishing area catches to indicate, for each gear type and each species, the estimated composition of stocks intercepted in each fishing area. The data are printed out in tabular form, such as the "Stock Composition of Fishing Area Catch" table which illustrates, by percent and pieces, the estimated portion of any stock(s) caught in a known fishing area. An actual year's catch for any species, gear type, and fishing area is separated to show the estimated stock composition of the fishery. Conversely, all presently identifiable stocks are individually summarized in the "Fishing Area Catch of Specific Stocks" tables; for each of these stocks, all fisheries are listed. Some fisheries may not intercept a given stock at all, and some fisheries will intentionally target and intercept the stock. Fisheries managers are able to formulate enhancement and fisheries management scenarios using the PRUNES base. For example, the PRUNES base may be used by the fisheries managers to predetermine the possible results of modifying fisheries regulations to reduce or increase catches in a fishery or for any stock coastwide. In addition, PRUNES is used to determine which stock should be enhanced and where the enhanced stock can best be harvested with minimal interception problems.

Throughout 1981, several significant changes have taken place in PRUNES. These changes have included:

- converting to metric all commercial catch files
- completing the commercial catch base to 1980 for U.S. and Canada
- including 1965-1970 catch data for chinook
- updating the codes for Washington State statistical fishing areas
- improving the system documentation and operating procedures
- fine-tuning the data elements in the catch files
- improving available stock/fisheries table formats.

Although much progress has taken place this year, further improvements are required. Once these improvements have been implemented, PRUNES will be a much more effective model for handling inquiries which arise from the ongoing international negotiations between Canada and U.S.A. on salmon interceptions.

PRUNES is an extremely valuable tool in the major decisions and analysis to evaluate the proposed international U.S.-Canada fisheries agreement. Each of the fisheries policy issues can be tested with the present catch base to speculate whether each issue is a loss (U.S. intercepting Canadian stocks) or a gain (Canada intercepting American stocks). As the signing of the international agreement between U.S.A and Canada draws nearer and the Salmonid Enhancement Program begins its program plans for Phase II, the Pacific Region-U.S.-Canada Negotiating System will take a more prominent role in DFO's assessment of fisheries management and enhancement opportunities.

Contact: Margaret Peters, Planning
Biologist, Program
Development Branch.

CISFIN

The Cost-Income model of the Salmon Fishing Industry is a computer model which analyzes the financial position of the salmon fleet. Recent data for catch, costs and incomes are used to project the financial position of the commercial salmon fleet under several scenarios. This model was designed to examine the impacts of policy options, such as the cost recovery program recommended in the Pearse report. In 1981, the documentation of this model was completed and an introductory paper describing the operation of the model was prepared.

Contact: Heather Fletcher (CISFIN),
Economic Advisor, Program
Development Branch.

SEP Manageability Studies

A primary concern in the development of an enhancement facility is managing the returning enhanced stocks. Manageability problems arise when a number of stocks and/or species intermingle as a result of common feeding or spawning behavior and, more frequently, common migratory pathways.

Enhancement projects, combined with regulatory initiatives can, in many cases, be designed to counteract these impacts, but a general lack of data and significant biological uncertainty combine to make the fine tuning of management for overlapping fish populations a difficult task.

Through SEP funding and direction from the Geographic Working Groups, manageability studies have been undertaken in areas which have been already affected by SEP enhancement production and in areas where enhancement has been proposed.

In 1981, the following manageability studies were funded by the Salmonid Enhancement Program and undertaken by Field Services Branch:

South Coast

a) Knight Inlet

A preliminary test fishing program was initiated in Knight Inlet (Area 12) in mid-August and continued for five weeks in an attempt to assess the feasibility of using a gillnet test fishing program to assess pink stocks.

The purpose of the program was to identify migration routes, timing, and stock strengths in anticipation of commercially harvesting future enhanced Glendale stocks. The test program, hampered by low returning stocks, tides, debris, and seals, indicates that Knight Inlet does not lend itself favorably to gillnet test fishing. A report on the study is expected in 1982.

Contact: Al Gould, Management
Biologist, Field Services
Branch, Nanaimo.

b) Johnstone Strait Stock Separation

The inability to identify stocks and their timing in Johnstone Strait creates problems for precise fisheries management. Electrophoresis and/or morphometry could be a solution to the problem.

A sampling program of chum salmon from Areas 13, 14, 16, 17, 18 and Fraser River was implemented from October to December 1981. Samples of muscle tissue and liver, and meristic data were collected from approximately 2,500 fish from 11 Vancouver Island and mainland streams.

An electrophoretic analysis may reveal significant stock differences which can then be applied as a management tool to identify specific stocks within a mixed stock fishery. Preliminary information appears to confirm that differences do exist in chum stocks in the South Coast area.

Contact: Al Gould, Management Biologist, Field Services Branch, Nanaimo; Dr. Terry Beacham, Pacific Biological Station, Nanaimo.

c) Kennedy Lake Studies

Fishable surpluses of sockeye salmon from the lake enrichment experiment at Kennedy Lake are expected in 1984. A seine test fishery was carried out in the area to determine suitable locations for a fishery and to monitor stock composition and abundance.

In addition, a survey was done to determine the feasibility of installing a hydroacoustic fence on the lower Kennedy River. A suitable location was found; the fence will be installed in the fall of 1982.

Contact: Steve Heizer, Management Biologist, Field Services Branch, Nanaimo.

d) Barkley Sound Management Studies

Sockeye from lake enriched stocks in Barkley Sound were taken and examined for parasites. This information is used to discriminate between Somass stocks, Great Central Lake stocks, and Henderson Lake stocks. These data aid in management actions to protect Henderson Lake stocks, which are still below harvestable levels.

In addition, a test fishery for chinook salmon was carried out. These data aid in managing the gillnet fishery in Alberni Canal. In addition, the data were used, for the first time, in the development of a computer model.

Contact: Steve Heizer, Management Biologist, Field Services Branch, Nanaimo.

e) Georgia Strait Sportfishing Creel Survey

SEP was a major contributor towards the funding of the year-long (July 1980-June 1981) creel survey completed in 1981. The purposes of the survey were: to establish the catch of chinook and coho salmon by recreational fishermen, to measure the effort expended to achieve those catches, and to establish the proportion of marked chinook and coho in the catch. The latter would essentially reflect SEP's contribution to the catch, since the major source of marks are hatchery-produced fish.

Approximately 50,000 interviews with anglers were processed to obtain daily fishing effort and catch per unit of effort. In addition, 136 flights of the whole study area were made on 54 flight days to enumerate the sportfishing fleet.

An estimated 895,000 salmon were caught by anglers. Of this total, 553,000 were coho and 320,000 were chinook, with the remainder comprising other salmon species. The fishing effort expended to achieve these catches was 724,000 boat trips.

The results of the study will be published in 1982.

Contact: Tom Shardlow, Steve Heizer, Management Biologists, Field Services Branch, Nanaimo.

North Coast

a) 1981 Babine Fence Tagging Program

Tagging of adult sockeye was again carried out at the Babine fence, but in a more intense fashion than in 1980. The program was initiated to identify some of the timing characteristics of

These Babine stocks are en route to spawning grounds.

the Pinkut Creek and Fulton River enhanced stocks and their relationship with other Babine stocks for the purpose of determining the feasibility of harvesting enhanced sockeye in a discrete manner. A total of 11,779 tags were applied between July and September.

Each unenhanced system was examined for tagged sockeye on a weekly basis. Tags from Pinkut and Fulton were also recovered. Upper and lower Babine River recoveries were made during a Peterson mark-recapture program on these systems.

Overall, approximately 15 percent of the applied tags were recovered. The run timing of individual stocks in 1981 does not seem to be very different from pre-enhancement years. Commercial fish harvesting at the Babine fence appears to be feasible if economic and engineering studies to be conducted in 1982 are positive.

Contact: Ron Kadowaki, Management
Biologist, Field Services
Branch, Prince Rupert.

b) Areas 3X, 3Y and 4 Tagging Programs

The overlapping timing of Nass and Skeena stocks of sockeye salmon during their migration through a common fishing area in Sub-Areas 3X and 3Y has caused fishery management problems inherent in any mixed stock fishing situation. By tagging stocks in these statistical areas and recovering them at the Meziadin fishway, Babine fence and in other smaller spawning streams, it should be possible to obtain some data that would allow for a more efficient harvest of these fish as they approach their natal rivers. The tagging results should reveal timing and migration routes of these stocks and establish if they can be separately harvested.

Past tagging programs occurred in 1944-48, 1957-58, and 1968. Major recoveries were at the Babine fence and in the Area 4 commercial fishery. During these programs, Nass recoveries were minimal because the Meziadin fishway was not yet in operation.

Tags were applied to 1,639 sockeye, 192 chum, 28 chinook, 112 coho, 202 pink, and two steelhead. Percentages of tags recovered were 19.8 percent sockeye, 12 percent chum, 6.3 percent coho, 10.7 percent chinook, and 4.9 percent pink.

Contact: Ron Kadowaki, Management
Biologist, Field Services
Branch, Prince Rupert.

c) Skeena-Nass CWT Reconnaissance

If SEP is to effectively enhance Nass and Skeena River chinook stocks, it is essential to learn more about the catch distribution and timing of these stocks. In the absence of hatchery stocks, this must be accomplished through marking wild stocks. In order to undertake such a marking program, it is necessary to identify locations where juveniles will be sufficiently numerous to justify trapping and marking efforts. The first step is to identify spawning areas where fish are most abundant and to select trapping sites accordingly. Reconnaissance efforts were initiated in August and September on: Cranberry River, Kiteen River, Bear River, Azuklotz Creek, Salix Creek, Sustut River, Spawning Lake, Johanson Lake, Morice River and Nanika River. In addition, 78 chinook salmon from the Bear River were sampled for length, sex, age, and egg retention.

Contact: Ron Kadowaki, Management
Biologist, Field Services
Branch, Prince Rupert.

d) Kitsumkalum River Salmon Escapements and CWT Recovery

During the month of September 1981, a dead-recovery program was conducted on the Kitsumkalum mainstem in order to obtain spawning escapement and coded-wire tag recovery information.

During the course of the program, two chinook had coded-wire tags from the 1976 brood year release of 25,853 reared and tagged fry. In addition, 280 chinook were sampled for length, sex and age. This year saw the first return of a major age class (age 5) from a tag release of reasonable size.

Contact: Ron Kadowaki, Management
Biologist, Field Services
Branch, Prince Rupert.

e) Cumshewa Inlet Chum Tagging Program

In 1978, a Japanese-style chum hatchery was built on Pallant Creek near Moresby Camp, Cumshewa Inlet, to provide more fish to the historical fall chum fishery on the Queen Charlotte Islands. In order to manage this enhanced stock effectively, it was important to learn the timing and mixing of the Pallant Creek chum, other chum stocks and other species of salmon in and around Cumshewa Inlet. A tagging program, initiated in 1980, continued through 1981 with the objective of determining an optimal commercial fishery time and boundary area, for Pallant chums, which would have the least impact on unenhanced stocks and species. Feasibility and recommendations for a test fishery were also being considered.

Nearly 9,000 tags were applied to chum salmon in and around Cumshewa Inlet over the last two years, and initial tag recovery indicated that most chum salmon within the terminal area were indeed of Pallant Creek origin, and no serious stock mixing or timing problem existed. However, environmental variation may, in some years, cause shifts in stock abundance and migration patterning, and further studies may be required.

Contact: Linda Orman, Management
Biologist, Field Services
Branch, Prince Rupert.

f) Kitimat Arm Chinook Tagging Update

The original study was conducted in the Kitimat Arm-Douglas Channel area from May-December, 1980, to estimate chinook population size, migration patterns and to monitor sport fishing activity. As chinook salmon in this area are the targets of a significant sport fishery, the information aids in management of the fishery and in planning and development of the Kitimat hatchery, which will soon be in operation. The updated portion of this report is currently being compiled into a technical and data report.

The study used a mark-recapture method to estimate population size and migration rate. Floy tags were applied to 1,427 immature chinook feeding in salt water, most of which were two years old (2_1 age class). Based on saltwater sport fishing recaptures of these tags, the population of the Arm and Channel was estimated at 55,000 fish. Coded-wire tag data and scale analysis indicated that about five percent of these fish were from the Kitimat pilot hatchery, about 53 percent were from other Canadian hatcheries and the rest were wild fish or American hatchery fish. Mortality due to sport fishing was estimated at 10,000 fish, based on a creel census conducted as part of the study. Just under a third of the losses were "shakers," or undersized fish, which often die after being caught and released.

During their first ocean year, 98 percent of the Kitimat hatchery chinook leave the inlet or perish. In 1981, 10 percent of the coded-wire tag recoveries of Kitimat hatchery chinook were taken in the local sport fishery, 40 percent in Canadian commercial fisheries and 50 percent in the Alaskan troll fishery. This indicates a pattern of immature chinook rearing in inlet headwaters during the winter and spring and moving gradually to the outer coast during the summer. A few chinook remain near their native streams but most fish migrate north along the coast, using rearing habitat in many coastal inlets. Therefore, the population of young chinook in Kitimat Arm-Douglas Channel consists of local stocks and migrants from more southerly areas. These young fish appear to be highly mobile, with substantial immigration and emigration from the area.

Contact: Dave Peacock, Management
Biologist, Field Services
Branch, Prince Rupert.

g) Smith Inlet Management

The return of fertilized sockeye to Long Lake exceeded expectations. The escapement was 215,000, and the catch was 160,000 sockeye. Daily counts through the Docee fence are used to predict run size; however, this is often a rather late indicator, and in 1981, there was a good deal of difficulty trying to establish how large the run would be. (Fishermen were originally told there would be no fishery but were later allowed substantial fishing times.) Severe management problems developed because the large, late run was not predicted.

Observations of the two major spawning streams indicated that this escapement was not excessive for Long Lake, particularly if the system is to be fertilized in 1982, as planned. A number of proposals are being developed to resolve the management problems posed by large, unpredictable returns. In 1982, echo sounding will be carried out in the outer areas of Smith Inlet, as well as in streams and lakes. The Department is also working on a run prediction model which will make greater use of data from outside catches. In addition, spawning ground escapement surveys will be upgraded in order to determine whether too many fish are returning to the spawning grounds.

Contact: Dave Peacock, Management
Biologist, Field Services
Branch, Prince Rupert.

h) Rivers Inlet Sockeye Management

SEP began funding this management program in 1979 in order to test the "enhancement by management" concept—that some stocks could be enhanced most effectively by improved management prediction and assessment tools. If fisheries are to be regulated more precisely, the fishery managers must have greater confidence in their assessment figures before attempting to close a large, economically-important fishery. Enhancement in Rivers Inlet could be successfully attempted in this manner.

The echo sounding program at the head of Rivers Inlet provides the daily pattern of sockeye stock buildup at the head of Rivers Inlet. In 1981, echo sounding estimates of sockeye--a peak of 770,000--were comparable to the escapement count of 800,000 on the grounds.

Some years of tight control are still necessary in order to return the system to its optimum spawning production level of about one million sockeye, but with continued good assessment methods, the outlook is very optimistic.

Contact: Dave Peacock, Management
Biologist, Field Services
Branch, Prince Rupert.

i) Rivers Inlet Test Fishing

In conjunction with the improved sockeye management plan, a test fishing program was also initiated, as it was felt that echo sounding did not provide an early enough warning system in terms of early stock size. In 1981, the program ran for 15 days, mainly as a pilot to establish appropriate fishing locations and patterns. A fisherman with 42 years' experience in Rivers Inlet was hired to do the test fishing. The catches were good, and the preliminary indication is that the catch patterns in this "outside" test fishery can be developed into useful predictors of the incoming run.

Contact: Dave Peacock, Management
Biologist, Field Services
Branch, Prince Rupert.

j) Bella Coola Management/Atnarko Enumeration

Now that the Atnarko odd-year pink salmon have been restored to former levels, fishery management problems--occurring when pink and chum are fished together--have returned. Snootli Creek chum salmon, needed for brood stock at the hatchery, are being taken in the fisheries which target on the large number of pinks. Although the Atnarko tower is a good indication of both pink and chum escapement, it is located too far upstream to aid in fisheries management.

Therefore, in 1981, 10,000 pink and 2,000 chum salmon were tagged in Fisher-Fitz Hugh Sounds and in Hakai Pass to provide information on stock composition and run timing. At each tagging period, a different colored tag was applied.

When the various colored tags appeared (in the commercial fishery, at the counting fences, or on the spawning grounds), staff related the colored tag to the tagging time and were able to establish the runs' timing.

The extensive commercial fishery and good effort by the local fishery officers and stream guardians resulted in excellent tag recovery. As well, a SEP project, operating on the Kakweiken River, was able to check all 500,000 returning pink salmon for tags.

Of the fish tagged in Area 8, 89 percent of the recoveries were caught in the Area 8 fishery or counted past the Atnarko tower. Percent tag recovery in each area was approximately: four percent in Area 12 (Kakweiken River fishway), two percent each in Areas 7 and 9, and one percent each in Areas 6, 10, and 29.

Contact: Dave Peacock, Management
Biologist, Field Services
Branch, Prince Rupert.

Fraser River, Northern B.C. and Yukon

The 1981 studies focussed on spawning ground recovery of previously coded-wire tagged chinook and coho on the Upper Fraser, Chilcotin, Shuswap, Deadman, Salmon (Langley) and Upper Pitt Rivers. In addition, reconnaissance was carried out in the North and South Thompson Rivers in preparation for 1982 coho coded-wire tagging programs. The data generated from these studies are beginning to play an important part in chinook and coho management recommendations and will be extremely valuable when production from Fraser River hatcheries comes on line.

Other programs initiated this year were undertaken to evaluate methods to enumerate spawning escapements more accurately. These programs included an evaluation of hydroacoustic methods and the current methodology used to enumerate Harrison River chinook.

a) Upper Fraser River Juvenile Chinook Tagging Program

A juvenile chinook tagging program was carried out on the Upper Fraser River near T te Juane Cache during June, 1981. This work completed a three-year program of coded-wire tagging designed to identify wild stocks from the Upper Fraser River in the sport and commercial fisheries.

During 1979 and 1980, chinook fry were captured, using downstream inclined plane traps in the main river channel. Most of the chinook fry were too small to tag (under 45 mm in length), so the fry were reared artificially prior to tagging and release. Concern about the impact of this type of program on the life history of the fish resulted in a change in the program in 1981.

In 1981, fry were captured later in the year from the warmer side channels, marshes and an oxbow lake, then immediately tagged and released without artificial rearing. The main capture methods used were minnow traps and beach seines.

Fewer fry were captured for tagging than in the previous two years because fry were not reared and trapping was limited. During the 20-day duration of the program, 30,400 fry were captured, of which 23,700 were released with coded-wire tags.

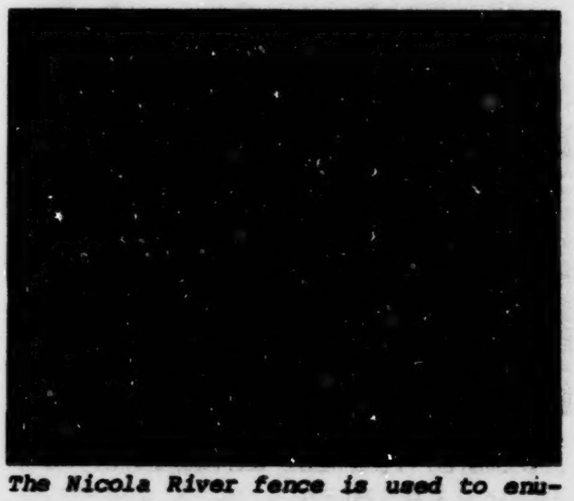
Contact: Brian Pearce, Management
Biologist, Field Services
Branch, New Westminster.

b) Nicola River Water Management Study

The provincial Ministry of Environment assumed the lead role in a water management study of the Nicola River during 1980. The study was initiated several years ago by concerned ranchers in the watershed who had contracted a professional engineering firm to model the hydrological characteristics of the area and recommend measures to resolve water-use conflicts.

As part of the cooperative watershed management approach, the Fraser River, Northern B.C. and Yukon Division cooperated with the Habitat Management Division and the provincial Fish and Wildlife Branch to identify current fish populations, fisheries maintenance flow requirements and associated salmonid carrying capacity and enhancement potential.

The present spawning population and distribution of chinook salmon were determined, and emigrating juvenile salmonids were sampled during the fall period.



The Nicola River fence is used to enumerate and sample chinook and coho.

The combined fisheries data will be used to set salmonid enhancement targets and recommend the best enhancement approach for the Nicola River. The total water management study will identify areas and criteria important for salmonid production and ensure that the fisheries and other water-use resources use the Nicola River water for the mutual benefit of all.

Contact: Brian Pearce, Management
Biologist, Field Services
Branch, New Westminster.

c) Chilcotin River System Chinook CWT Recovery Program

The Chilcotin River flows east from the coastal mountains for 230 km and joins the Fraser River 51 km south of Williams Lake.

Coded-wire tagging programs were conducted on the Chilcotin River in 1977 and on its main tributary, the Chilko River, in 1978 and 1979; some 395,000 chinook fry were tagged. Each fall since 1979, adult chinook sampling programs have been carried out in the system in order to estimate the number of tagged fish in the escapement.

The missing adipose fin on this chinook (recovered from the Chilko River) indicates the presence of a coded-wire tag in the fish's snout.

In 1981, the program was localized in the 63-km section of the Chilcotin River from its confluence with Chilko River to the outlet of Chilcotin Lake, and on the Chilko River from the Chilko Lake outlet 23 km downstream.

No tagged chinook were found on the Chilcotin River; however, 11 chinook with tags were found on the Chilko River. Based on the escapement and age composition, the number of tagged fish in the escapement was estimated to be between 26 and 33 five-year-old chinook from the 1976 brood.

These tag recovery data will be combined with data from commercial and sport fishery sampling to determine run timing and contribution to different fisheries.

Contact: Brian Pearce, Management
Biologist, Field Services
Branch, New Westminster.

d) Deadman River Chinook Salmon CWT Assessment

The Deadman River is a moderate sized stream that flows south into the Thompson River approximately 4 km downstream of Kamloops Lake.

In 1978, a total of 5,100 chinook salmon fry were released with coded-wire tags (CWTs) during the second year of a two-year CWT program intended to document their marine distribution and exploitation. The autumn of 1981 was the final year of significant returns of tagged fish from that program.

The escapement in 1981 was extremely low. Extensive spawning ground surveys recovered only seven carcasses from an estimated escapement of 25. No tagged fish were recovered.

Some tag recoveries have been reported in the commercial catch and these data are being used to determine migration patterns and exploitation rates of Fraser River chinook.

Contact: Brian Pearce, Management
Biologist, Field Services
Branch, New Westminster.

e) Lower Shuswap River Chinook Salmon CWT Assessment

A program to recover three-year-old chinook salmon that were marked with CWTs during 1979 was conducted in the lower and middle Shuswap Rivers during October 1981.

A total of 141,000 and 58,000 chinook fry of the year was released with CWTs during the springs of 1979 and 1980. The fall of 1981 was the first year of minor returns from those programs.

During September 1981, 800 carcasses were examined from an estimated escapement of 5,500 in the lower Shuswap and 500 in the middle Shuswap River. Approximately one percent (or eight of those examined) were three-year-olds; no marks were recovered. This program served to refine the recovery techniques which will be used to assess the major return of four-year-olds expected in 1982.

Contact: Brian Pearce, Management
Biologist, Field Services
Branch, New Westminster.

f) Upper Fraser River (Tête Jaune) Chinook CWT Assessment

A program to recover three-year-old chinook salmon which were coded-wire tagged as reared fry in 1979 was conducted in the Upper Fraser River near Tête Jaune Cache during September 1981.

A total of 77,000 chinook fry of the year was released with CWTs in 1979, the first year of a three-year program designed to document the distribution and exploitation of Upper Fraser chinook. Approximately 45,000 and 24,000 juvenile chinook were released with CWTs during 1980 and 1981, respectively.

During 1981, 200 chinook carcasses from an escapement of approximately 1,800 were examined for marks. Since none of these fish were three-year-olds, no marks were recovered. A refined methodology will be applied to the major recovery effort planned for 1982.

Contact: Brian Pearce, Management
Biologist, Field Services
Branch, New Westminster.

g) Salmon River (Langley) Coho CWT Assessment

The Salmon River is a small stream which enters the Fraser River west of Fort Langley. During 1978, 1979 and 1980, coho smolt trapping and coded-wire tagging were conducted on the Salmon River and a tributary, Coghlan Creek. The numbers of coho tagged in the three years were: 1978 - 13,400; 1979 - 32,100; 1980 - 30,200.

During 1979 and 1980, spawner enumeration and mark recovery surveys were carried out in order to calculate smolt-to-adult survival rates and to calculate contribution of Salmon River coho to various sport and commercial fisheries. The escapement estimates were made by observing live and dead coho while walking the stream on successive occasions (dead pitch) and then applying a correction factor to account for double counting and sighting conditions. However, using this method of enumeration, there is considerable uncertainty about the escapement estimate and consequently, the calculated smolt-to-adult survivals.

During 1981, a fish trap was installed at the mouth of the Salmon River in order to accurately enumerate and sample the spawning population. At the same time, the escapement was enumerated, using the methodology previously employed in 1979 and 1980. Comparisons could then be made between the more accurate fence count data and the data generated by the "dead pitch" method.

Unfortunately, the fence was washed out by floods on two occasions and failed to enumerate all of the escapement. Extrapolation of the fence count to compensate for the period when the trap was not fishing suggests that the "dead pitch" methodology may slightly underestimate the actual escapement; however, the results were inconclusive.

Due primarily to the greater sample size, the fence trap data greatly improved the information about age composition and incidence of tagged fish in the escapement.

The Salmon River is the only system on the Fraser River for which several years of coho smolt output and escapement information exists. These data will be of considerable importance for the future management of wild and enhanced coho stocks.

Contact: Neil Schubert, Management
Biologist, Field Services
Branch, New Westminster.

h) North and South Thompson Coho Reconnaissance

A program to establish spawning populations, rearing potential, and to determine sites for a coho coded-wire tagging program was carried out on four tributaries of the Thompson River in 1981. The four tributaries studied were Lion and Louis Creeks and Salmon and Eagle Rivers.

Lion Creek is a small, clear water tributary, which enters the North Thompson approximately 10 km north of Avola. The spawning population was approximately 600 coho in 1981. Lion Creek was considered a poor candidate for a CWT program due to poor rearing potential and low spawning population.

Louis Creek is a moderate-sized tributary of the North Thompson, located approximately 50 km north of Kamloops. The population of coho spawners in this system in 1981 was approximately 900 fish. This system is approximately 40 km long and meanders through open farmland for most of its length. The rearing potential is good over most of its length, due to slow, deep pools and an abundance of instream and riparian cover. The rearing potential, large spawning population and presence of good numbers of coho juveniles throughout October and November make this stream a good candidate for a fall CWT program.

The Salmon River, which flows for approximately 65 km northeast to enter Shuswap Lake at Salmon Arm, is a tributary to the South Thompson system. The 1981 coho escapement to this river was approximately 450 fish. There is some rearing in this system; however, the areas are not large. The Salmon River was not considered to be a good candidate for a CWT program, due mainly to low spawning populations in 1981.

The Eagle River is a fairly large river which flows into Shuswap Lake. The headwaters are near Revelstoke, and the river flows approximately 50 km southwest to Sicamous. Coho in this system spawn mainly in the upper 15 km.

The spawning population for 1981 was estimated to be approximately 900 coho. However, due to the length and size of this system, capturing sufficient numbers of coho juveniles for a CWT program would be difficult.

Based on these investigations, preliminary exploration will be carried out in the summer of 1982 for juvenile coho rearing in Louis Creek and side channels of the North Thompson River, as well as in the Eagle River and Shuswap Lake in the Sicamous Narrows area. Suitable trapping areas will be located and fish will be sampled to determine when fish are of sufficient size for tagging.

Contact: Brian Pearce, Management
Biologist, Field Services
Branch, New Westminster.

i) Pitt River Coho CWT Assessment

Studies have been conducted in the Upper Pitt River system for five years. Escapement estimation began in 1977, and a preliminary biophysical inventory, which defined major rearing and probable spawning areas, was conducted during the summer of 1978.

A two-year coded-wire tagging program was initiated in 1979 to provide fishery contribution, timing and marine distribution data for the Upper Pitt River coho stock. A total of 168,000 juvenile coho was tagged during 1979 and 1980.

The objectives of the 1981/82 recovery program were to determine the:

- 1981 coho escapement to the Upper Pitt River system
- total number of marks in the escapement, and the relative contribution of each tag group to the total
- location and relative distribution of spawning, and the timing of spawning in each area
- age/length/sex characteristics of this stock.

Escapements were estimated visually by a combination of aerial and ground surveys. Coho that were holding in mainstem pools were enumerated by helicopter and weekly foot surveys of all known tributary and side channel spawning areas. Live spawners were enumerated visually and all carcasses were counted and examined for a missing adipose fin and then sampled for age, sex and length. The heads of all fish without an adipose fin were collected for tag analysis.

The 1981 coho escapement estimated at 3,300 was composed of ages 4_3, 3_2, and 2_2 individuals in the following percentages: 27 percent, 72.6 percent and 0.4 percent, respectively. The survival to escapement of these tag groups was low, with those tagged as yearlings surviving at three times the rate of those tagged as underyearlings. The rate of tag loss did not increase significantly during the period of ocean residency. A preliminary analysis of the CWT recovery data confirms that tagging rearing juveniles in the autumn is a viable stock assessment technique.

Contact: Neil Schubert, Management
Biologist, Field Services
Branch, New Westminster.

i) Echo Sounding Evaluation

Echo sounding for chum salmon enumeration to aid in fishery management in the mainstem Fraser River was evaluated in 1981. A potential sounding site was identified, and several sounders currently owned by the Department or the International Pacific Salmon Fisheries Commission were tested.

The borrowed sounders were barely suitable for in-river use because of their frequencies, TVG types and transducer qualities. This type of equipment was not designed for consistent results or for in-river work. Data from this equipment could be useful only for indexing large-scale upstream movements, such as the sockeye and pink runs being sounded by the IPSFC.

The present state of the Fraser chum run (i.e. low numbers per day) dictates the use of a more precise echo sounding methodology. In addition, because there were no hard data on chum abundance from the test fisheries or the spawning ground observations, a method which could arrive at hard data would be necessary.

The University of Washington seminar on hydroacoustic stock assessment and discussions with American experts indicate that the Fraser salmon runs could be very accurately enumerated by the prudent application of state-of-the-art hydroacoustic equipment. The only negative factor is cost of the equipment.

The following recommendations were made:

- determine the accuracy level desired in enumerating the salmon runs to the Fraser
- investigate the cost of equipment which would achieve the accuracy desired
- determine the existing accuracy level in the enumeration of the salmon runs to the Fraser
- weigh the costs of obtaining accuracy against the benefits of increased accuracy and make a decision which will influence the enumeration of Fraser salmon for the next 10 to 20 years
- conduct a workshop on the potential riverine sounding.

Contact: Gerry Buxton, Senior
Technician, Field Services
Branch, New Westminster.

j) Harrison River Chinook Enumeration Study

The purpose of this study was to investigate the adequacy of present enumeration techniques and recommend improvements to this method or recommend new methods to enumerate chinook in this area. The existing method of chinook enumeration appears to rely on a few visual observations from the limited access points on the river. At times, these observations have been supplemented by aerial or boat-based observations, but there has been no consistency in the pattern or intensity of observation.

Observations this year indicated some of the yearly problems which could be encountered (i.e. high flows, dirty water, wind, fog) and which would disrupt the quality and quantity of data collection.

The estimated number of chinook spawners in the Harrison this year was 10,000.

It was recommended that a more intensive and consistent series of visual observations by boat and by air be established, along with an intensive dead-pitch program coordinated with local SEP personnel.

Contact: Gerry Buxton, Senior
Technician, Field Services
Branch, New Westminster.

Coastwide Salmonid Head Recovery Program

The Salmon Services and Special Projects Unit receives funding from both SEP and the Field Services Branch to carry out the province-wide coded-wire tag Head Recovery Program and salmonid ageing service (Regional Scale Lab), as well as projects such as biological sampling of salmon for size and age.

Contact: Don Bailey, Chief, Salmon
Services.

Fishermen who turn in a fish head that contains a coded-wire tag receive information on the fish's origin.

Head Recovery Program

The program, started in 1973, samples commercial and sport catches for the coded-wire tags placed in the heads of some juvenile salmonids in hatcheries or streams.

In 1981, approximately 20 percent of the commercial catch of chinook, coho and steelhead was sampled for missing adipose fins (the small fleshy fin anterior to the tail). This is a signal that the head of the fish contains a coded-wire tag--a minute piece of stainless steel wire etched with a specific code denoting the origin of that fish. Sampling was carried out at processors in Prince Rupert, Namu, Tofino, Ucluelet, Victoria, Vancouver, Steveston, and Port Hardy--the latter a new location for sampling in 1981. Because of the much-reduced catches in the troll fishery in 1981, only 750,000 fish were sampled--a 40-percent decrease from 1980--and only 19,500 marks were recovered.

The voluntary sport head recovery program continued in 1981. Anglers turned in a total of 10,200 heads from adipose-clipped salmonids at the 150 head depots located in marinas, boat docks, tackle shops and Fisheries offices throughout B.C. Recent information indicates that approximately one in five marked sport heads is turned in by anglers. Anglers who turn in marked heads receive information on the origin of their marked fish, a Head Recovery button, the "Salmonid" newsletter and other Fisheries and Oceans information. Each becomes eligible to win one $500 prize and six $50 prizes in one of the eight annual bonus draws. In 1981, $500-prize winners included anglers from Gold River, Quathiaski Cove, Delta, and Fort Saskatchewan, Alta., while $50 winners included anglers from as far as Manitoba and California.

In spite of poor commercial catches in 1981, sport fishermen sent in five percent more heads than in 1980.

Early results from 1981 indicate a strong showing of Capilano hatchery marks; 15 percent of all commercial mark recoveries and 58 percent of all sport mark recoveries were from Capilano. Although a high proportion of Capilano releases were marked in these brood years because of various research programs being carried out there, these figures indicate the value of this hatchery to B.C. fisheries. Salmonids from 832 different tag codes were captured in 1981, of which 282 were Canadian codes. Approximately four million Canadian and 20 million U.S. juvenile salmon are coded-wire tagged each year.

The tag data on timing, migration, and exploitation of Canadian and U.S. stocks are crucial to fisheries management and U.S.-Canada salmon interception negotiations. The data are also vital for the evaluation of SEP facilities and research, and for future enhancement planning.

The Salmon Service Unit also participates in commercial and sport log-book programs, coordinates the purchases and supply of coded-wire tags for marking, coordinates the reporting of coded-wire tag and fin-clip release information with U.S. marking agencies, and coordinates and processes the recovery information of Floy and Petersen disc tagging programs.

Contact: Vic Palermo, Biometrician
Programmer, Don Bailey,
Chief, Salmon Services.

Regional Scale Laboratory

The Regional Scale Laboratory is responsible for the ageing of scale samples from all species of salmonids, as well as freshwater fish and herring. Scale samples, as well as otoliths and fin rays, are submitted by various DFO branches and divisions, other Canadian and U.S. agencies, and consultants. In 1981, laboratory staff aged a total of 199,000 scales, otoliths and fin rays; this represents an overall increase of four percent over 1980.

In 1981, a scale ageing technician was located in the field at Sointula during the sockeye fishery in Johnstone Strait. Scale analysis was used to separate the stocks and determine the migration and timing of Nimpkish sockeye. The unique scale pattern of this race allowed management decisions to be made to protect this weak stock from exploitation.

Lectures on scale readings were given by lab personnel at educational institutions. In addition, approximately 1,000 scale books were pressed in acetate and distributed to various U.S. agencies for use in stock separation programs.

Scale lab personnel have also expanded their duties to lend their expertise in court cases. Scale characters can be used to identify species and to determine if fish have migrated into non-tidal waters.

Contact: Yvonne Yole, Supervisor,
Regional Scale Laboratory.

Pilot "FISH"

FISH (Fishculture Information System for Hatcheries) is a computerized data management system which operates on APPLE II Plus micro-computers. It is intended for on-site use at major SEP production facilities and designed to be "user friendly" and useful to facility staff.

The data content of FISH was determined after surveying the records of all major SEP facilities. Incubation, rearing and adult sampling programs now are available in standardized formats. Utility programs were also included, and are able to perform statistical, bioengineering and fishculture-related calculations.

The adult data programs were in use last fall. Full-scale tests on the incubation and rearing sections are scheduled for the spring and summer of 1982.

The major advantage of the computerized system is the speed and efficiency of reporting and editing entries. For example, after the sampling of approximately 6,000 jack and adult coho for coded-wire tags at the Quinsam hatchery, the data were entered and summarized within one week of the last sample date. Previously, this process would take as long as six months to complete.

The utility programs have proven to be valuable for calculating mark-recovery effort for assessment programs, designing aeration towers, designing safe procedures for mixing and heating water supplies, preparing feed tables, and calculating dosages of chemical treatments for fish diseases. Benefits of the utility programs lie in their easy use, the speed and precision in which reports can be produced, and the availability of a wide range of expertise.

Contact: Cameron West, Assessment
Biologist, Enhancement
Operations.

Surplus Egg and Fish Sales

DFO policy states that when natural and facility escapement targets of enhanced salmonid stocks have been met, surplus eggs may be offered for sale or donated for research. In 1981, some 5.4 million salmonid eggs were supplied to commercial aquaculturists, community development groups, public involvement projects, and researchers. Of this total, there were 4.1 million coho eggs, 800,000 chinook eggs, and a total of 500,000 pink, chum and steelhead eggs. Commercial aquaculturists purchased 67 percent of the total, paying $10 per thousand for green eggs and $14 per thousand for eyed eggs. (Researchers and Special Projects receive eggs free of charge.) "Green" eggs describe the very early stage of development following fertilization or prior to fertilization. The eggs must be transported green, or at the later eyed stage, because the eggs are very shock-sensitive between these two stages.

Total revenue generated by egg sales in 1981 was $46,132.

Adult salmon which are surplus to natural or facility spawning needs are either sold by tender or identified as Indian food fish, depending on the facility. In 1981, a total of 151,000 kg of live fish and 37,000 kg of carcasses (generally post-spawning fish) from facilities at Robertson Creek, Capilano, Quinsam, Puntledge, and Inches Creek were sold. Revenue from these sales to fish processors totalled $278,000.

Indian food fish from the Big Qualicum facility included approximately 43,200 adult coho, 22,600 jack coho, 5,000 chum, 480 jack chinook and 65 adult chinook.

Contact: Carol Cross, Junior Assessment Biologist, Ted Perry, Bio Program Coordinator, Facility Operations.

Fish Food Quality Control Program

SEP Facility Operations and the West Vancouver Laboratory have cooperated to implement a feed quality control program in 1982. Through chemical analysis of both ingredients and finished products, feed quality problems can be identified quickly enough to prevent distribution of poor quality feed, and diet specifications can be refined and standardized.

Analysis is to be carried out under contract by Can-Test Ltd., with all sample results to be stored on an "Apple" computer. Duplicates of each sample are to be retained at the West Van lab to provide a sample set for any cross-checking or further analysis that may be necessary.

Contact: Carol Cross, Junior Assessment Biologist, Facility Operations.

Student Research Projects

Under the auspices of the Career Oriented Student Employment Program (COSEP), two student projects of a general research nature were undertaken at south coast facilities. One project dealt with the relationships between water velocity, oxygen level, and biomass and has been expanded by the student into an honors thesis project. The other project, comparing the effectiveness of various early rearing strategies, requires further work in a following year.

Contact: Bruce Shepherd, New Projects Coordinator, Enhancement Operations.

Homing/Imprinting Data

Due to SEP's emphasis on central facilities, coupled with uncertainty as to the release strategies to employ, it was decided to fund a "state-of-the-art" report, collating all recent available data in the Pacific northwest regarding the effects of enhancement strategies on the homing of salmonids. The study and report was done by D.B. Lister and Associates Ltd. The results are proving to be useful for design of satellite hatchery evaluation and marking programs.

Contact: Bruce Shepherd, New Projects Coordinator, Enhancement Operations.

Program Direction and Communications

Salmonid Enhancement Board

In August 1978, the federal Minister of Fisheries and Oceans, in consultation with the provincial government, established the Salmonid Enhancement Board to provide him directly with advice and recommendations concerning the management and direction of the program.

The Board is the senior advisory group for the program and its membership consists of a total of 12 representatives from the federal and provincial governments and from the private sector. Private-sector appointees represent the interest of commercial and recreational fishing, native people, the forestry industry and the public-at-large.

In 1981, the Board met three times. Much of the Board's time and effort in 1981 was devoted to planning and preparation for SEP's Phase II and to developing appropriate recommendations to the Minister.

Board members also undertook a number of field inspections of facilities in order to further their understanding of the program.

Contact: Pam MacKenzie, A/Secretary to
the Salmonid Enhancement
Board.

Salmonid Enhancement Task Group

The Salmonid Enhancement Task Group is the primary public advisory group to the Salmonid Enhancement Board and SEP. The purpose of the Task Group is twofold: to provide the views and advice of a broadly-based, non-governmental group on matters which are within the responsibility of SEP, and to support SEP to maintain the program as a positive and dynamic contribution to the needs and aspirations of the B.C. community.

The Task Group consists of 25 members representing various user/interest groups, such as the commercial, sport and native food fishermen, and the processing industry. Also on the Task Group are from mining, forestry, B.C. Hydro, Consumers' Association of Canada, education, agriculture, media, tourism, municipal government, Chamber of Commerce and taxpayers.

1981 was the fifth full year of activity for the Task Group. The group held four general sessions, three in Vancouver and one in Port Hardy. In addition to these full-group sessions, several committee meetings were conducted via conference telephone calls.

In January 1981, the Task Group had its annual joint meeting with the Salmonid Enhancement Board to discuss additional funding for Phase I, cost recovery, and initial Phase II planning.

At its April meeting, the Task Group asked for a detailed proposal on the Kitimat hatchery project. Following the presentation, the Task Group voiced its concern that smaller scale development should be more emphasized.

In June, the Task Group presented its brief to the Pearse Commission on Pacific Fisheries Policy. This submission called for: an agreement and commitment, with public input, for Phase II; implementation of cost recovery; increased resource protection; integration of management policies with enhancement; and sufficient secure funding, coupled with the flexibility of a balanced enhancement program.

In August, the Task Group travelled to Port Hardy to get a firsthand look at steelhead and small stream enhancement projects, as well as a large mining operation. On the Keogh River, the Task Group was able to see the benefits of in-stream boulder placement; and, at O'Connor Lake, the SETG saw lake-pen rearing of steelhead smolts. At the Island Copper Mine, Task Group members saw the controls and monitoring which a responsible company adopts for reducing the possible negative impacts on the salmonid resource and its habitat.

At the November meeting, seven committees of the Task Group were involved in the preparation of a report outlining the group's major concerns for Phase II. The final report was completed at year-end and was presented to the Salmonid Enhancement Board in January 1982.

In the report, the Task Group reemphasized its support for SEP and again expressed its desire for the implementation of a balanced program of enhancement, habitat protection and management for Phase II.

Contact: Tom Murray, Chairperson,
Salmonid Enhancement Task
Group.

SEP Information Program

The SEP information program is designed to increase public awareness of SEP and to stimulate interest in salmonids. The information program has a number of components directed to the general public, school children, and specific user/interest groups.

Salmonid

Seven regular issues of the newsletter were published during 1981. The newsletter features stories on projects, activities, and issues relating to the salmonid resource. "Salmonid" circulation is currently 25,000.

Subscriptions are available at no cost. The newsletter is mailed out to fishermen, native Indian groups, educators and other interested individuals and groups upon request.

Two semiannual updates outlining progress on current projects and programs were also distributed in the newsletter.

A special "Salmonid," commemorating the tenth anniversary of the Capilano hatchery, was produced in October, 1981.

Brochures

Guide brochures continued to be developed for SEP's major facilities. In 1981, two brochures were produced; for Tlupana Inlet hatchery on the west coast of Vancouver Island, and for Chilliwack River hatchery in the Fraser Valley.

An updated version of the "Where and When to See Salmon" brochure was produced.

Fact Sheets

Fact sheets are brief descriptions of specific elements of salmonid enhancement. In 1981, one fact sheet, "Fishways" was produced; four others, "Spawning Channels," "Economic Benefits of SEP," "Stream Care," and "Tagging," were written in 1981; they will be produced in 1982.

News Releases

Several news releases were disseminated to the media around the province. Most releases dealt with community development and major hatchery contracts.

Slide Tapes

Two slide-tape productions; one on public involvement, the other on enhancement techniques, were scripted. The productions will be completed in 1982.

Displays

A large display, using the modular Expo system, was constructed in 1981. It was used extensively at various locations, including:

- Vancouver Island Exhibition, Nanaimo, August 13-16
- Coho Festival, West Vancouver, September 3-5
- Deas Island Park Opening, Delta, September 27
- Aberdeen Mall, Kamloops, October 15-17
- Science Fair, Robson Square Media Center, Vancouver, October 23-30
- North Vancouver Outdoor School, Squamish, November 13
- National Science Teachers' Convention, Vancouver, December 2-5
- Langley and Fort Langley, December 14-16

Plans are to have the display revised in early 1982. It will feature new photographs, additional panels, and a section for dispensing SEP information, such as the "Salmonid," fact sheets, and brochures. Tabletop displays will be designed and constructed as well. These will be used by the community advisors in their meetings and presentations at schools, with clubs, and other general public groups.

Slide File

A library of SEP-related slides was maintained during 1981. Duplicates were made of most slides. The slides were categorized and stored in special binders.

Contact: James Boland, Head, Public Involvement Unit.

SEP Annual Reports

The projects comprising SEP are laid out in two annual reports: this large annual report which outlines briefly each SEP project, and a summary annual report which provides an overview of the program. The large annual report is available in limited quantities. The summary annual report is mailed to all "Salmonid" subscribers and to other interested parties.

Contact: Judy Barnetson, SEP Planning Biologist.

Educator's Package

Four major areas comprise the duties of the SEP educational coordinator: writing, conducting in-service sessions for users and potential users of the Salmonids in the Classroom curriculum package, providing input in the development of SEP information materials, and liaison.

During 1981, the educational coordinator revised the Salmonids in the Classroom material. Six educators and one SEP community advisor, all familiar with the material, provided input. The updated version will be submitted to the Ministry of Education in the early summer of 1982. The new package is more streamlined and easier to use, but the content is virtually unchanged. The revised version will be available in the fall of 1982.

The coordinator also produced a catalog of all audio-visual presentations available through the Depart-

The Educator's Package helps teach students about the salmonid resource.

ment's Information Branch. More than 60 presentations were screened, and a synopsis was written for each film/slide tape presentation. The catalog can be used by the Information Branch as well as Public Involvement Program staff.

A rough draft of the primary (kindergarten to grade three) component of Salmonids in the Classroom was developed, and these materials were field-tested in the fall of 1981. A second draft will be ready in the spring of 1982.

The educational coordinator conducted eight in-service sessions for teachers using (or planning to use) the Salmonids in the Classroom package. Two workshops were also conducted for fishery officers in order to familiarize them with the educational materials and assist them in preparing presentations to school groups.

Upon request, the educational coordinator critiqued SEP information materials, such as fact sheets and film texts.

On an ongoing basis, the coordinator also responds to requests from package users and other individuals and groups associated with the production or distribution of the educational materials.

Contact: Linda Bermbach, Educational Coordinator; James Boland, Head, Public Involvement Unit, Special Projects.

Appendices

A. SEP Fish Production, Forecast Catch and Production Capacity

Summary of 1981 SEP Fish Production*

Species	Juveniles Released	Expected Adult Production
Sockeye	203,797,200	2,747,209
Chum	98,263,254	985,771
Pink	8,634,380	259,971
Coho	5,875,989	766,610
Chinook	19,888,149	396,013
Steelhead	723,125	16,554
Cutthroat	84,860	5,560
TOTAL	337,266,957	5,177,688

* Includes production from all SEP facilities and projects, and lake enrichment.

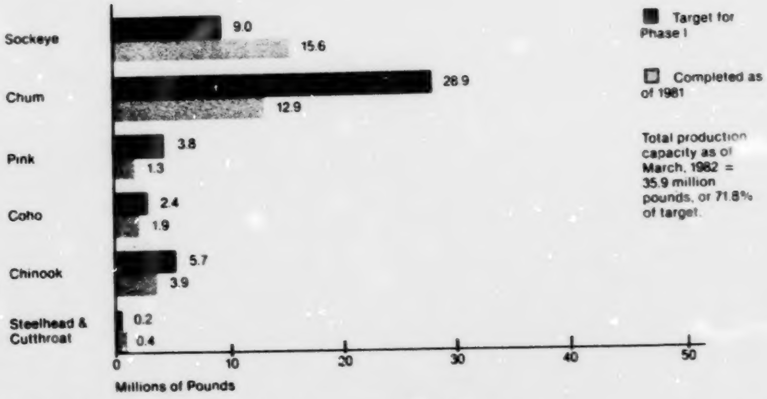
Forecast Catch from Existing SEP Projects* at Full Capacity**

Species	Canadian Catch Thousand of Pieces	Millions of Pounds
Sockeye	3,868,627	19,916,425
Chum	1,261,678	14,649,321
Pink	348,668	1,513,322
Coho	661,305	3,654,380
Chinook	592,499	5,522,064
Steelhead	31,751	327,033
Cutthroat	6,280	64,684

* Facilities constructed before SEP as well as SEP projects.

** Projected Canadian commercial, sport and native food fish catches, each year.

SEP Production Capacity by Species: Phase I Targets and Performance to Date*



Total production capacity as of March, 1982 = 35.9 million pounds, or 71.8% of target.

* Production capacity measures the capacity of facilities which have been constructed since 1977 (SEP facilities only) and are now operational. The capacity is stated in terms of expected future adult catches, using current facility capacities, current expected egg to adult survival rates of enhancement techniques, and projected future Canadian catch rates.

B. *Financial Statements*

SEP Expenditures by Program Area (in Thousands of Dollars)

	1977/78	1978/79	1979/80	1980/81	1981/82
Program Area					
Major Production Projects	$ 1,621	$ 6,754	$11,974	$12,847	$12,897
Minor Production Projects	252	726	1,098	1,461	1,212
Pilot Production Projects	283	284	135	244	181
Facility Operations and Maintenance	1,344	2,803	3,820	5,777	8,150
Community Development Projects	453	1,929	2,813	3,168	2,969
Lake Enrichment	307	676	1,095	1,345	1,454
Public Involvement	505	829	830	874	1,051
Reconnaissance/Feasibility Studies	1,581	754	1,508	1,588	990
Manageability and Environmental Studies	764	1,725	1,267	1,488	730
Evaluation/Assessment Studies	354	608	157	402	332
Research Studies	459	461	644	691	396
Program Planning and Direction	791	1,032	1,196	1,633	775
Provincial Program (Federal Share)	364	865	688	744	376
Provincial Program (Provincial Share)	264	289	1,243	1,250	1,250
TOTAL	$ 9,342	$19,735	$28,468	$33,512	$32,753
Source of Funds					
SEP Phase I	$ 7,878	$17,146	$24,725	$28,462	$26,911
DFO* Contribution	1,200	2,300	2,500	3,800	4,592
Provincial Share	264	289	1,243	1,250	1,250
TOTAL	$ 9,342	$19,735	$28,468	$33,512	$32,753
Phase II Program Development	–	–	–	–	$ 2,466

* Department of Fisheries and Oceans.

Major Production Projects

Design and Production

Project	**Amount**
Engineering Management	$ 1,119,600
Land DPW	219,000
Tenderfoot	407,600
Tsolum	24,900
Big Qualicum	9,500
Nitinat Hatchery	1,528,200
Glendale River	466,900
Kitimat Design & Construction	2,121,600
Quesnel Hatchery	2,098,900
Eagle Design & Construction	90,000
Inch Construction	785,800
Chehalis Construction	3,867,200
Chilliwack Construction	158,000
Total	**$12,897,200**

Minor Production Projects

Project	**Amount**
Administration	$ 636,800
Stream Catalogue	5,900
Stream Rehabilitation Maintenance	23,400
Fishway/Fence Maintenance	16,000
Public Participation Support	14,300
CDP Participation Support	147,600
[illegible]	[illegible]
Fraser-Thompson Reconnaissance	700
Railroad Creek Channel	200
Worth Creek Channel	1,500
Ed Lyon Channel	300
Billy Harris Channel	700
Borden Creek	200
Street Creek	3,500
Hemming Lake	2,700
Scott Cove	2,800
Colquitz Creek	35,000
Central Reconnaissance	2,200
Kainet Feasability	11,900
Selloomt	9,000
QCI Reconnaissance	8,900
Peach Creek	1,100

Minor Production Projects (continued)

Westholme Channel	28,900
Keogh River	18,500
Camera Channel	21,000
Copper Hatchery	46,800
Yukon Potholes	1,200
Vancouver Rehabilitation	43,400
Sacus Boxes	10,000
Koksilah Fishway	4,200
Read Creek Fishway	20,800
Total	**$1,212,300**

Pilot Studies

Project	**Amount**
Mathers Creek	$110,900
Penny Pilot	5,100
Stuart Pilot	28,900
Kitsumkalum Pilot	36,200
Total	**$181,100**

Facility Operations and Maintenance

Project	**Amount**
Enhancement Ops. Admin.	$ 901,800
Quesnel Pilot Hatchery	198,500
Inch Hatchery	264,500
Chehalis Hatchery	10,000
Chilliwack Hatchery	467,600
Cheakamus/Tenderfoot Hatchery	55,800
Indian River	26,000
Jones Creek Spawning Channel	56,700
Capilano Hatchery	384,200
Birkenhead Hatchery	98,000
Big Qualicum River Project	505,200
Little Qualicum Spawning Channel	268,200
Puntledge Hatchery	560,500
Chemainus Chinook	63,100
Tlupana Inlet Development	451,700
Nitinat Hatchery	473,200
Robertson Creek Hatchery	470,400
Thornton Creek Hatchery	15,700

Facility Operations (continued)

Quinsam River Hatchery	619,900
Snootli Creek Hatchery	284,100
Kitimat River Hatchery	173,900
Fulton River Spawning Channel	261,900
Pinkut Creek Spawning Channel	293,700
Kitsumkalum River Pilot Hatchery	47,400
Pallant Creek Hatchery	401,700
Maintenance - General	465,200
Tlupana Maintenance	101,000
Robertson Creek Hatchery	92,400
Kakweiken Fishway	20,500
Bella Coola	117,200
Total	**$8,150,000**

Community Development

Project	**Amount**
Administration	$ 328,000
Water Sampling	5,000
Native Advisors	58,200
Tagging	5,500
Technical Advisors	400,200
Chehalis	185,500
False Creek	61,500
Seymour River	44,300
Alouette River	14,700
Nanaimo River	211,600
Cowichan River	227,700
Sliammon	171,500
Sechelt	73,000
Thornton Creek	56,800
Port Renfrew	96,500
Nimpkish	255,100
Bella Bella	205,400
Kincolith	139,500
Kispiox	187,400
Masset	231,800
Total	**$2,959,200**

Public Involvement

Project	**Amount**
Administration	$ 483,700
Information Administration	206,700
Educators Package	31,600
P.P. Administration	71,500
SEP Film	36,900
SETG Public Advisory	67,800
District 1	17,200
District 2	49,200
District 3	14,900
District 4	3,300
District 5	11,500
District 6	22,600
District 7	700
District 8	20,600
District 9	12,300
Total	**$1,050,500**

Research

Project	**Amount**
Program Support	$ 2,000
Hatchery Manual	18,300
Hatchery Rearing	66,000
Time and Size Release	48,500
Chum Incubation Requirements	15,000
Smolting Requirements	8,100
Growth Control	1,300
Controlled Reproduction	46,300
Salmonid Diet	36,500
Disease Control	3,200
Disease Survey	65,600
Stream Enhancement	37,700
Parasite Stock	17,700
Salmon Genetics	29,500
Total	**$395,700**

Lake Fertilization

Project	**Amount**
Program Management	$ 15,900
Juvenile Ecology	109,000
Adult Ecology	27,800
Surveys and Research	46,900
Treatment	805,800
Monitoring	448,700
Total	**$1,454,100**

Manageability and Environmental Impact Studies

Project	**Amount**
Hatchery Wastewater	$ 77,400
Coordination-Supervision	124,900
Thompson Adult Chinook	800
Upper Fraser Chinook	23,800
Chilko Chinook	14,300
Bessette Coho	10,300
Estuary Chinook	2,000
Salmon River Coho	1,200
Pitt River Coho	4,500
Kennedy Lake Enrichment	17,400
Barkley Sound Management	31,200
Rivers Inlet	2,900
Bella Coola Management	4,200
Smith Inlet Management	7,100
Central Coast Tagging	3,000
Kalum CWT Recovery	6,200
Sockeye Tag Babine Fence	14,400
Sockeye Tagging	7,500
Mark Recovery	376,700
Total	**$729,800**

Provincial Programs

Project	**Amount**
River Enhancement	$ 30,400
Headwater Stock Research	13,200
Sea-run Cutthroat Research	37,500
Chilcotin Enhancement	25,800
Thompson River Tributary Enhancement	25,600
Vedder River Steelhead	26,000
Vancouver Island Headwater Stocking	59,000
Vancouver Island Cutthroat Management	16,700
Keogh Pen Rearing	59,900
Upper Skeena Reconnaissance	35,100
Skeena Fry Stocking	46,600
Total	**$375,800**

Reconnaissance/Feasibility

Project	**Amount**
New Project Administration	$149,000
Water Quality	52,000
Upper Fraser	209,700
North Thompson	189,300
South Thompson	129,800
Chehalis	200
Glendale River Spawning Channel	148,800
Kitimat River Hatchery	111,200
Total	**$990,000**

Economics

Project	Amount
Direction/Support	$188,500
Five Account Evaluation	2,300
Economic Impact Study	1,100
Native Account	1,100
Community Industry Monitoring	900
Computing Administration	60,600
Epic Data Base	55,700
Production Model Development	4,200
PRUNES	6,100
Sport Fishing Survey	1,700
CISFIN Operations	1,900
Software Training	4,300
Catch Statistics & Licencing	2,700
Salmon Escapement Data	900
Total	**$332,000**

Program Planning and Direction

Project	Amount
Executive Director	$277,000
SEP Board	6,900
Native Trainees	6,300
Assistant Deputy Minister	9,600
Planning Administration	50,400
International Negotiations	5,100
Contracts/Consultants	5,000
Fraser NBC GWG*	4,500
South Coast GWG	6,600
North Coast GWG	7,000
Financial Advisor	182,200
Program Finance	19,000
Program Administration	15,700
Centrally-controlled Program Expenditure	71,700
COSEP (Student Employment Program)	81,800
Director Operations	26,200
Total	**$775,000**

*Geographic Working Group

C. *Salmonid Enhancement Board — List of Members*

D.D. (Donald) Tansley (outgoing Chairman)
A.W. (Art) May (incoming Chairman)
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C.W. (Wayne) Shinners
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(Pacific Region)
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D. Salmonid Enhancement Task Group — List of Members

Member	**Affiliation**
SETG Executive:	
Tom Murray (Chairman) 1975 Russet Way West Vancouver, B.C. V7V 3B3	B.C. Federation of Fly Fishers
George McKnight (Past Chairman) Box 764 Prince George, B.C. V2L 4T3	Chamber of Commerce
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Robert Marcellin #9 - 4644 Lazelle Terrace, B.C. V8G 1S6	Local government
Don McDermid 2255 Windridge North Vancouver, B.C. V7H 1B6	B.C. Federation of Fly Fishers
Terry Allen Placer Development #700 - 1030 W. Georgia Street Vancouver, B.C. V6E 2Y3	Chamber of Mines
Bruce Ott Placer Development #700 - 1030 W. Georgia Street Vancouver, B.C. V6E 2Y3	Chamber of Mines
Edgar Birch 11660 - 98A Avenue Surrey, B.C. V3V 2K9	United Fishermen & Allied Workers Union

Bill Jarvie 857 East 32nd Avenue Vancouver, B.C. V5V 2Y7	UFAWU
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SETG (continued)

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E. SEP Community Advisors

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F. Publications

A partial list of reports and papers published in 1981.

Fraser River

Hickey, D.G. and Lister, D.B. 1981. Salmonid enhancement baseline investigations at Stuart River, British Columbia, in 1980. Part II--adult chinook salmon survey D.S.S. Contract No. 07SB-FP501-9-1288. West Vancouver: D.B. Lister and Associates, 70 pp.

Lister, D.B., Wallace, T. and Hickey, D.G. 1981. Salmonid enhancement baseline investigations at Stuart River, British Columbia. Part I--1980 juvenile chinook salmon study (Volume I) D.S.S. Contract No. 07SB.FP501-9-1288. West Vancouver: D.B. Lister and Associates, 65 pp.

Murray, P.R., Hamilton, S.R., and Stewart, G.O., 1981. Studies on juvenile chinook salmon (Oncorhynchus tshawytscha) in the Bowron and Willow Rivers, B.C., during 1980. Vancouver: Envirocon Ltd., 86 pp.

Murray, P.R., Stewart, G.O., and Hamilton, S.F. 1981. Studies on adult chinook salmon (Oncorhynchus tshawytscha) in the Bowron and Willow Rivers, and Slim Creek, B.C., during 1980. Vancouver: Envirocon Ltd., 66 pp.

Olmsted, W.R., Whelen, M.A., and Stewart, R.J. 1981. 1980 Investigations of fall-spawning chinook salmon (Oncorhynchus tshawytscha), Quesnel, Blackwater (West Road) and Cottonwood River drainages, B.C. North Vancouver: E.V.S. Consultants Ltd., 119 pp.

Whelen, M.A., Olmsted, W.R., and Stewart, F.W.J. 1981. Studies of juvenile chinook salmon (Oncorhynchus tshawytscha) and other salmonids in the Quesnel River drainage during 1980. North Vancouver: E.V.S. Consultants Ltd., 105 pp.

East Coast Vancouver Island

Mace, Pamela and Fisher, Janis M. 1981. Bird predation on juvenile salmonids in the Big Qualicum estuary, Vancouver Island. Vancouver, 165 pp.

Central Coast

Birch, G.J., Slaney, T.L. and Milko, M. 1981. 1980 Investigations of downstream migration and rearing distributions in juvenile salmonids of the Kitimat River, B.C. Vancouver: F.F. Slaney and Company Ltd., 104 pp.

Hilland, Russ T., Farwell, M.K., and MacKinnon, C.N. 1981. Biological Reconnaissance of Kitimat chinook and results of pilot hatchery operations to May, 1980. Canadian Manuscript Report of Fisheries and Aquatic Sciences #1502, 46 pp.

Murray, P.R. and Hamilton, S.R. 1981. Baseline Biological Data on adult chum salmon in the Kemano River system, 1979. Vancouver: Envirocon Ltd., 77 pp.

Federal Research

Bilton, H.T. 1980. The influence of ocean age of parents on freshwater growth of steelhead progeny. Proc. of the 31st Ann. NW Fish Culture Conf., Courtenay, pp. 26-27.

Publications (continued)

Bilton, H.T. 1980. Effects of size and time of juvenile release on adult coho returns. Proc. of the 31st Ann. NW Fish Culture Conf., Courtenay, pp. 124-136.

Fagerlund, U.H.M., McBride, J.R., and Stone, E.T. Stress-related effects of hatchery rearing density on coho salmon. *Trans Am. Fish Soc.* 110:644-649.

Hunter, G.A., Donaldson, E.M., and Dye, H.M. Induced ovulation in coho salmon *(Oncorhynchus kisutch)* I. Further studies in the use of salmon pituitary preparations. *Aquaculture* 26: 117-127.

Hunter, G.A., and Donaldson, E.M. 1980. Experimental production of all female and sterile groups of coho salmon *(Oncorhynchus kisutch)* Proc. of the 31st Ann. NW Fish Culture Conf., Courtenay, pp. 234-241.

Jensen, J.O.T. 1980. Mechanical shock sensitivity, water uptake and development of internal egg pressure in coho salmon eggs. Proc. of the 31st Ann. NW Fish Culture Conf., Courtenay, pp. 184-193.

Jensen, J.O.T. 1981. Some spawning and incubation conditions that affect salmonid gamete viability and embryo development. p. 50. *Salmonid Broodstock Maturation. Seattle: University of Washington.*

Jensen, J.O.T., McLean, W.E., and Alderdice, D.J. Effects of accessory factors on survival of newly fertilized salmonid eggs treated with an antibiotic. *Aquaculture* 23:295-307.

McBride, J.R., Dye, H.M. and Donaldson, E.M. Stress response of juvenile sockeye salmon *(Oncorhynchus nerka)* to the butoxyethyl ester, or 2,4-D. *Bull. Environm. Contam. Toxicol.* 27:877-884.

McCallum, T.M., Higgs, D.A., and Owen, B.D. 1981. Chinook salmon diets based on prescribed performance and body composition. Proc. of the 31st Ann. NW Fish Culture Conf., Courtenay, pp. 225-233.

MacQuarrie, D.W., Markert, J.R. and Vanstone, W.E. Photoperiod induced off-season spawning of coho and pink salmon. pp. 41-52. *Salmonid Broodstock Maturation. Seattle: University of Washington.*

Stoss, J. Gametic storage in domestic rainbow trout (Salmo gairdnerie). pp. 54-55. *Salmonid Broodstock Maturation. Seattle: University of Washington.*

Stoss, J. Salmonid gamete storage p. 83. *Salmonid Broodstock Maturation. Seattle: University of Washington.*

Provincial Research

Slaney, P.A. and Harrower, W.L. 1981. Experimental culture and release of steelhead trout reared in net-pens at O'Connor Lake in British Columbia. Salmonid Enhancement and Rehabilitation Symposium, Humboldt State University, California, 13 pp.

Miscellaneous

Lill, Alan F. 1981. A Perspective on the Salmonid Enhancement Program in British Columbia *Bio-Engineering Symposium for Fish Culture (FCS Publ. 1): 274-281. Bethesda:* Fish Culture Section, American Fisheries Society.

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Glossary

Note: The definitions in this glossary are furnished by contributing writers and are relevant within the context of those writers' own sections.

activation: the process of initiating development in the fertilized egg after contact with water.

biomass: the weight or volume of biological material, e.g. - of zooplankton, phytoplankton, fish.

coelomic fluid: fluid in the body cavity.

cortisol: the principal cortical steroid hormone secreted by the interrenal tissue of salmon.

cryopreservation: storage of gametes (sperm and eggs) or embryos by freezing at very low temperatures.

double cropping: doubling the weight of fish produced per unit of space by moving the first group of fish out prematurely to another facility, (such as a rearing pen) or to a stream (by stocking fry) and rearing a second group of fish.

emigration: the downstream movement of juvenile fish.

female homogamety: existence of two similar sex chromosomes in the female.

fines: sand and silt measuring less than 0.1 cm or .01 m in diameter.

gabion: a wire basket filled with rocks and used for deflecting flows, protecting banks. Cylinder, wicker or woven metal bands are filled with earth for use in fortification for engineering.

glide area: a slow velocity, shallow stream section.

gonadotropin: the hormone which stimulates sexual maturation in salmon.

gynogenesis: a special form of parthenogenesis in which the egg is induced to develop without the contribution of chromosomes from the sperm.

histology: the study of tissue structure (microscopic anatomy).

hydrological survey: a survey or study of the waters of the earth, their occurrence, circulation and distribution, chemical and physical properties and reactions with the environment, including relation to living things.

imprinting: the process by which juvenile fish register environmental cues that enable them to return to their natal stream as adults.

interrenal: counterpart in fish to the adrenal cortex in higher vertebrates; the gland that produces the cortical steroids involved in the stress response.

kelt: a steelhead that has completed spawning.

lentic: "static water dwelling."

LHRH: a brain hormone which controls gonadotropin production and release.

limnetic: pertaining to the upper layer of the lake during the stratified period, i.e. May to October.

male heterogamety: existence of two dissimilar chromosomes in the male.

mesotrophic: having a moderate amount of dissolved nutrients; as in a moderately productive lake.

migration: the upstream movement of adults and occasionally juveniles (before smolting).

outplants: the juvenile fish transferred from a hatchery and released into their natal stream.

parthenogenesis: the development of an egg without fertilization.

radioimmunoasssay: measurements of extremely low levels of biological substances, by displacement of labelled material bound to a specific antibody.

residuals: steelhead (usually male) that do not go to sea, but remain in the stream as residents.

satellite facility: a permanent central station for incubation and early rearing, serving several separate stocks. Sites on the "satellite" streams are used only during adult capture and juvenile imprinting through short-term rearing and may not require any permanent structures.

spermiation: final maturation of sperm in the testes prior to spawning, characterized by an increase in water content.

stripped groundwater: well water with its (usually) high nitrogen content removed; generally, the groundwater is stripped by passing it through an aeration tower.

topographical survey: a survey made to obtain data from which may be made a topographical map. The map indicates the relative positions and elevations of man-made and natural features of a place or region.

trophic levels: feeding or production levels in a biological community. For example, phytoplankton are primary producers, zooplankton are grazers, etc.

vibrio diseases: systemic bacterial infections. At least two separate species of bacteria belonging to the genus Vibrio are known to cause the disease. It affects only those fish which are held in salt water.

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Fisheries and Oceans
Pêches et Océans

Province of British Columbia
Ministry of
Environment

Salmonid Enhancement Program
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